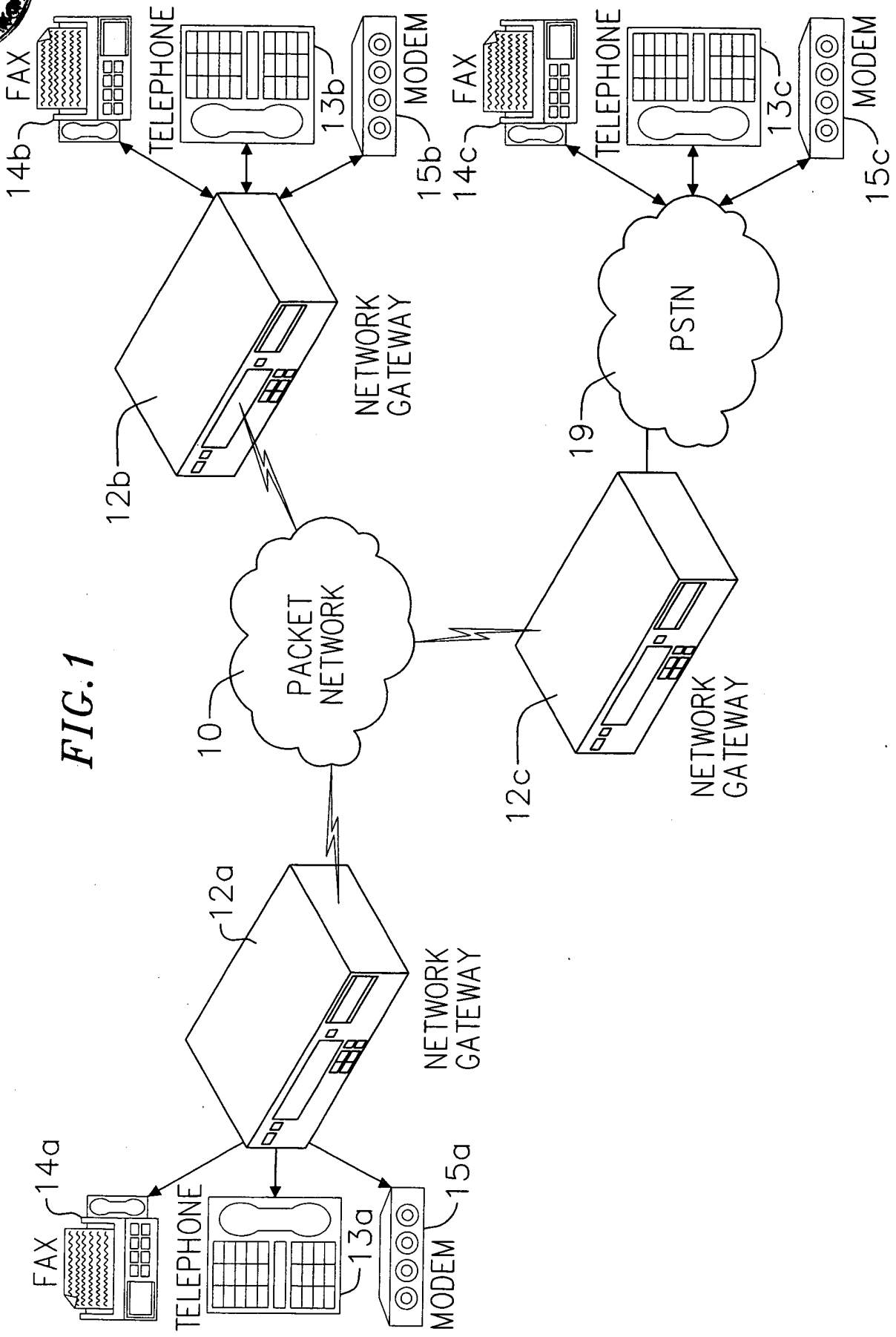


FIG. 1

FIG.2

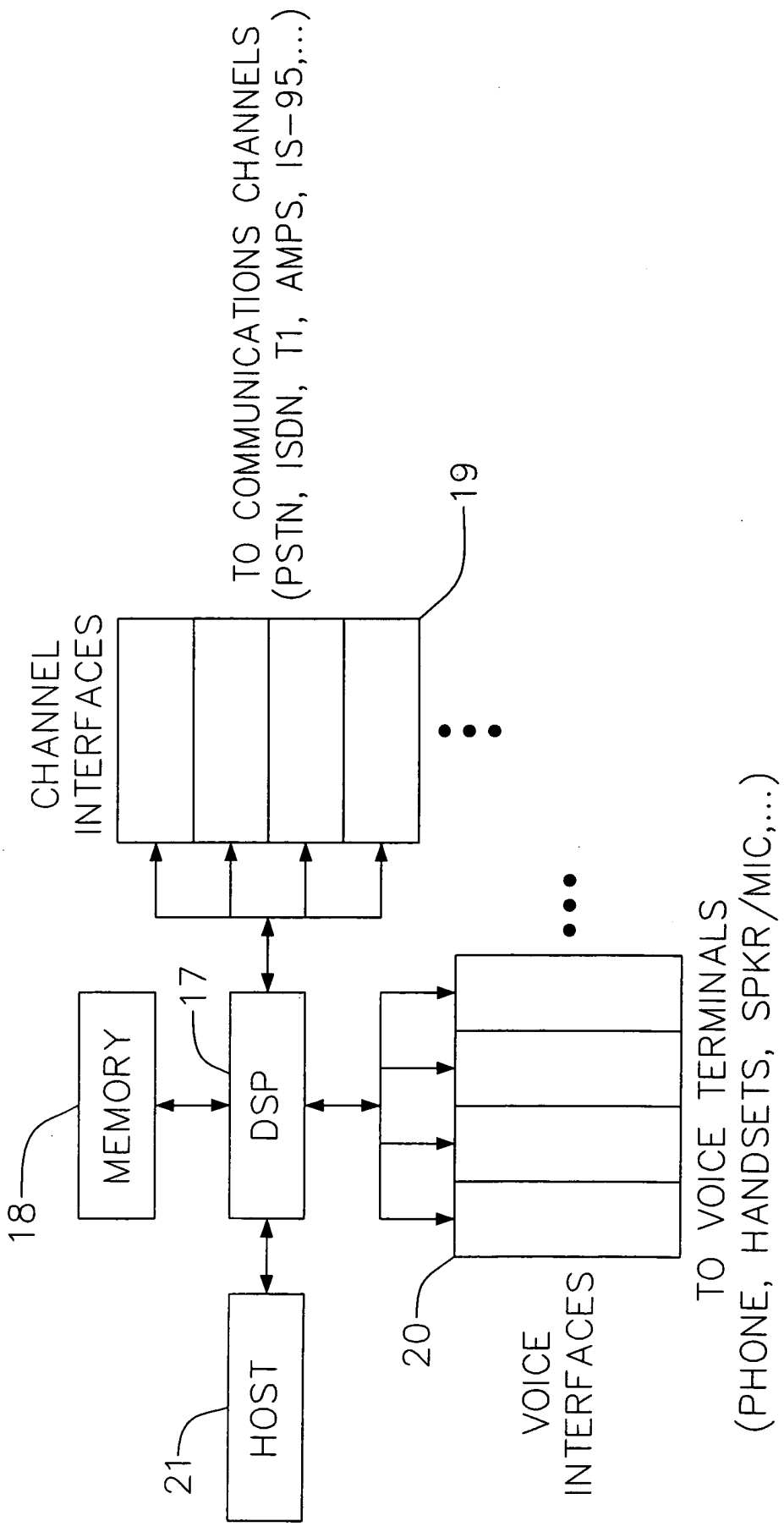
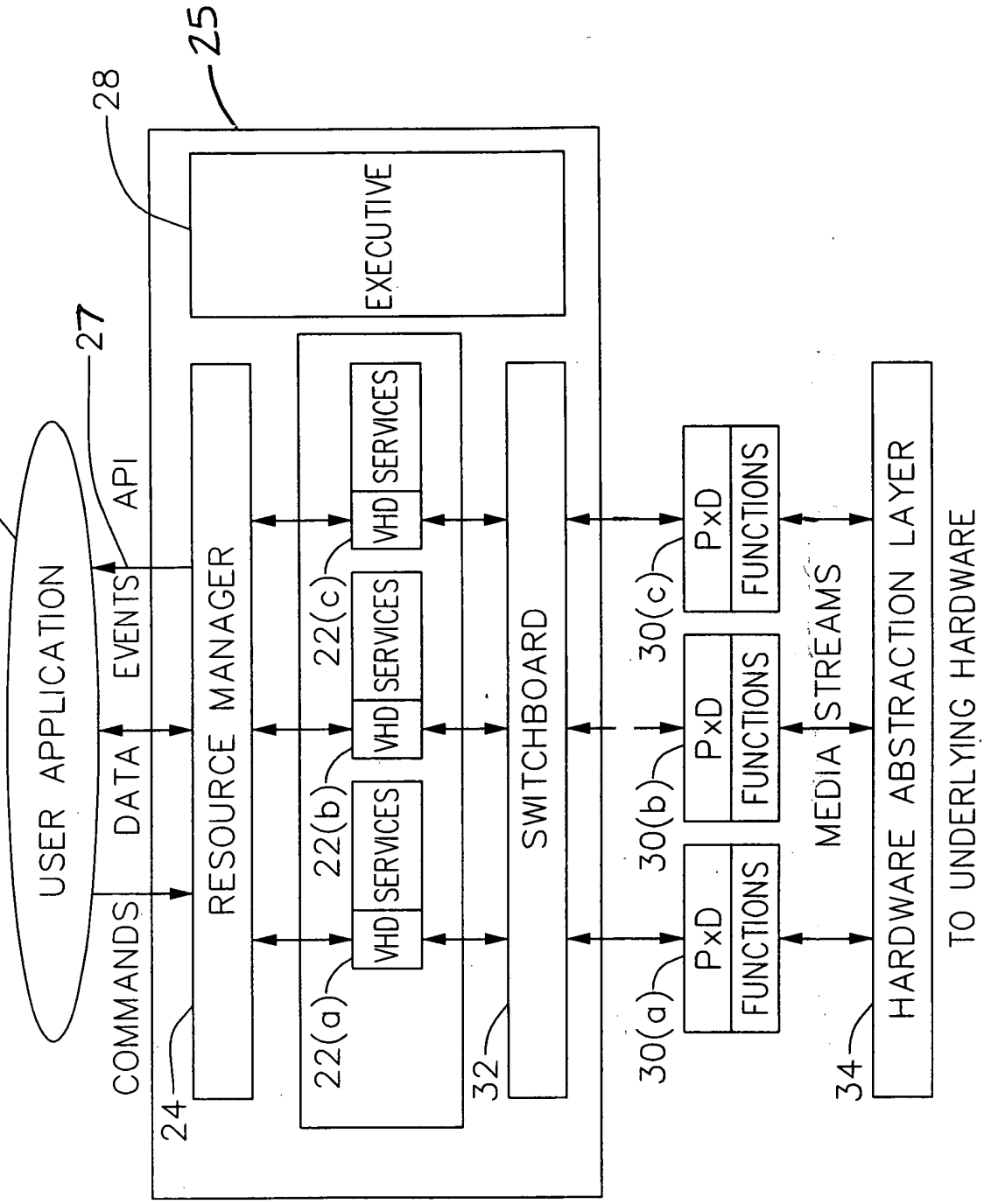

TO COMMUNICATIONS CHANNELS
(PSTN, ISDN, T1, AMPS, IS-95,...)
19
CHANNEL INTERFACES
17
DSP
MEMORY
18
HOST
21
20
VOICE INTERFACES
TO VOICE TERMINALS
(PHONE, HANDSETS, SPKR/MIC,...)

FIG. 3


25
28
EXECUTIVE
27
API
26
USER APPLICATION
EVENTS
DATA
COMMANDS
RESOURCE MANAGER
24
22(a)
22(b)
22(c)
VHD
SERVICES
32
SWITCHBOARD
30(a)
30(b)
30(c)
PxD
FUNCTIONS
MEDIA STREAMS
34
HARDWARE ABSTRACTION LAYER
TO UNDERLYING HARDWARE

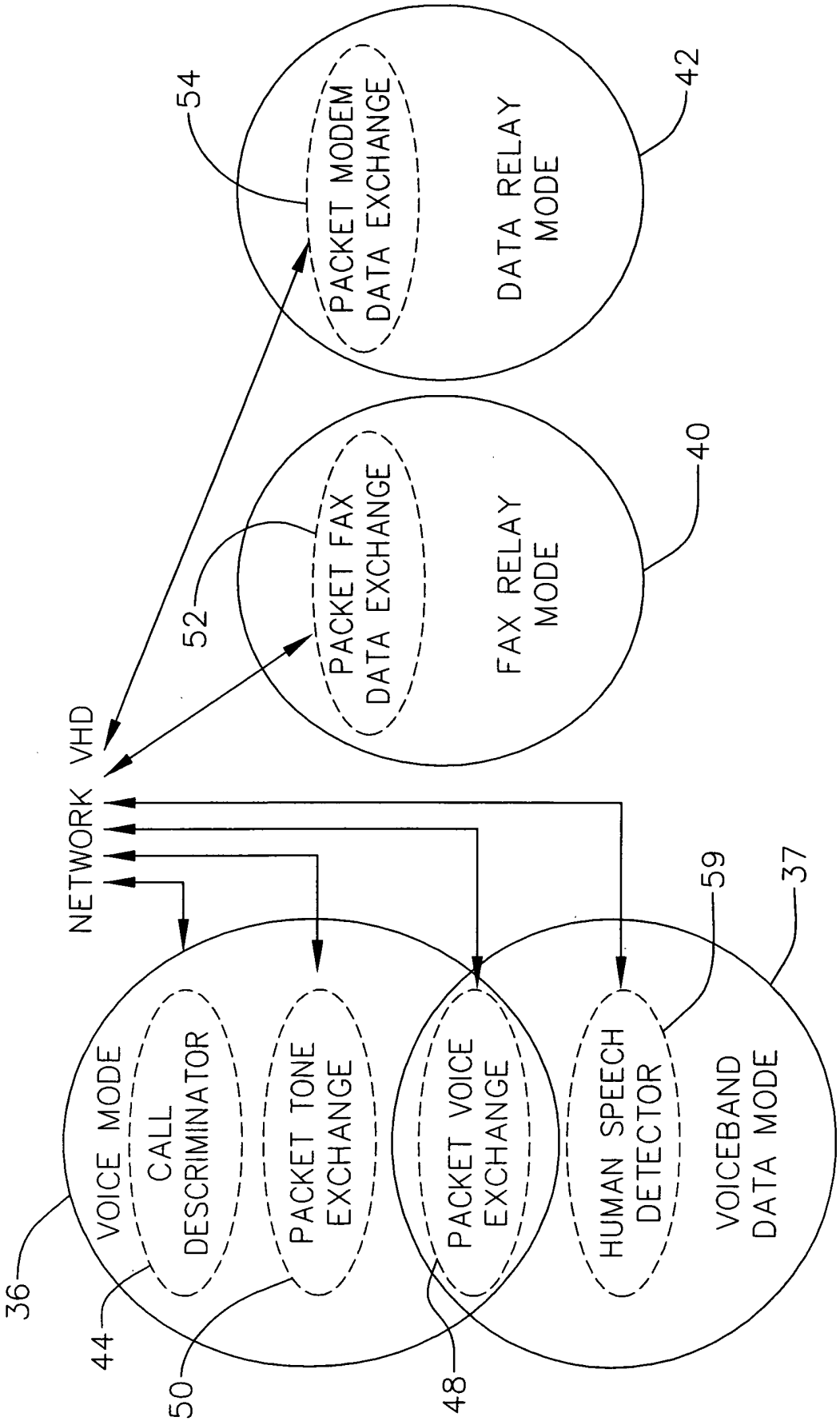

NETWORK VHD
DATA RELAY MODE
PACKET MODEM DATA EXCHANGE
FAX RELAY MODE
PACKET FAX DATA EXCHANGE
VOICEBAND DATA MODE
HUMAN SPEECH DETECTOR
PACKET VOICE EXCHANGE
PACKET TONE EXCHANGE
VOICE MODE CALL DESCRIMINATOR
36
37
40
42
44
48
50
52
54
59

FIG. 4

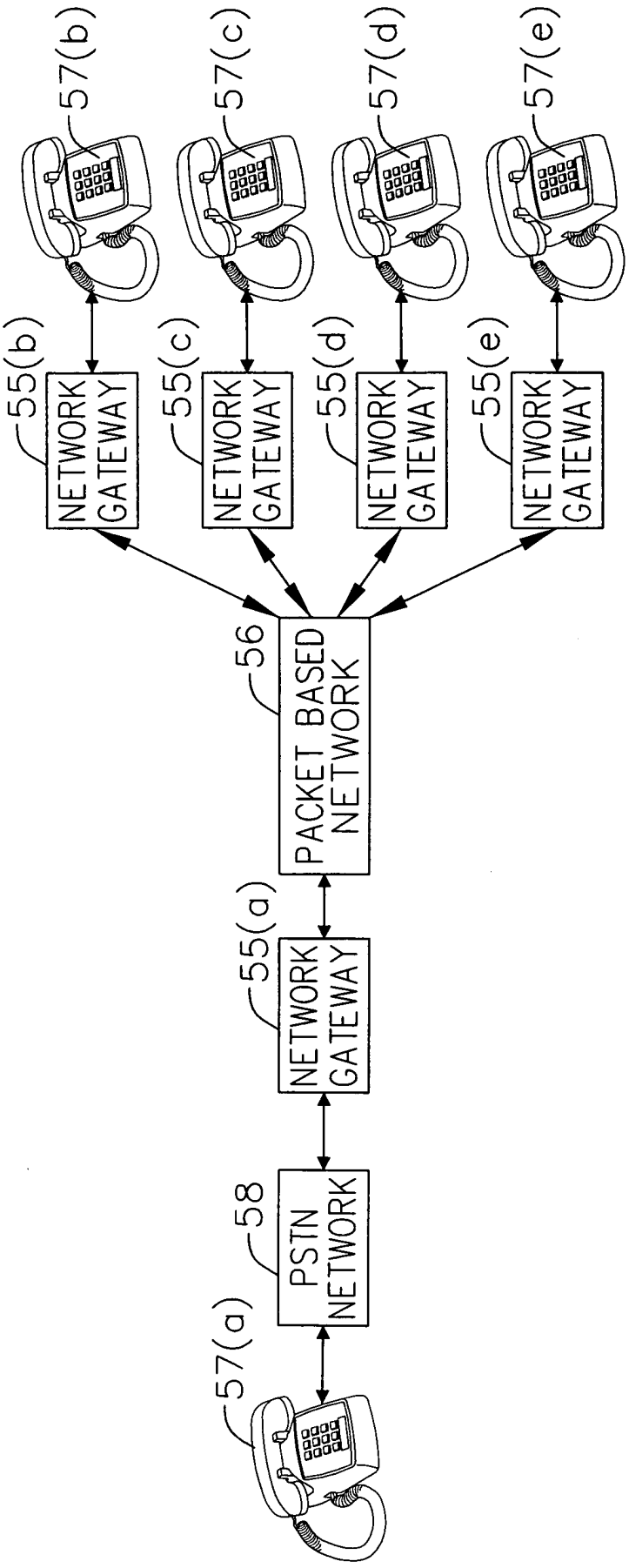

57(b)
57(c)
57(d)
57(e)
55(b)
55(c)
55(d)
55(e)
NETWORK GATEWAY
NETWORK GATEWAY
NETWORK GATEWAY
NETWORK GATEWAY
56
PACKET BASED NETWORK
55(a)
NETWORK GATEWAY
58
PSTN NETWORK
57(a)

FIG. 5

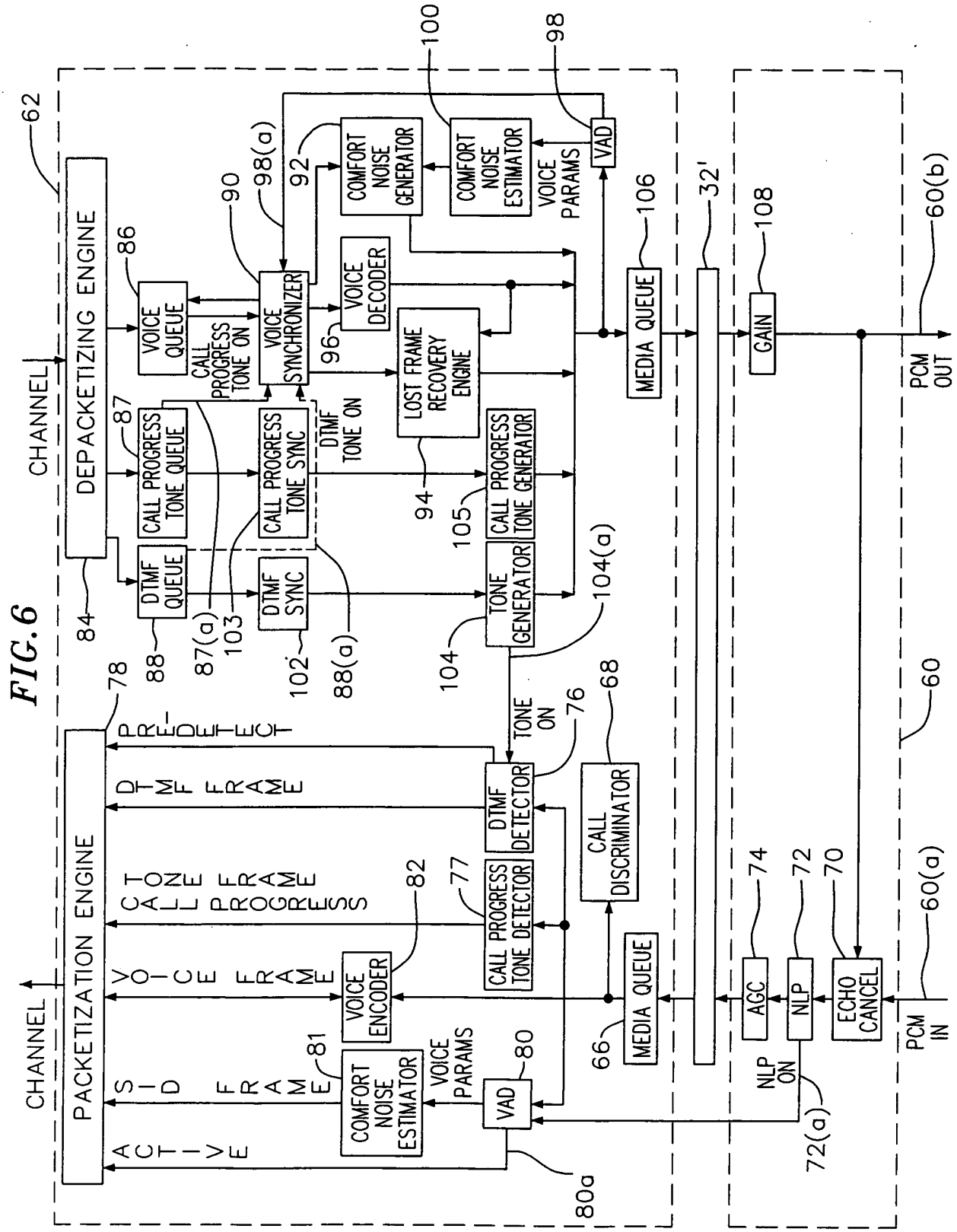
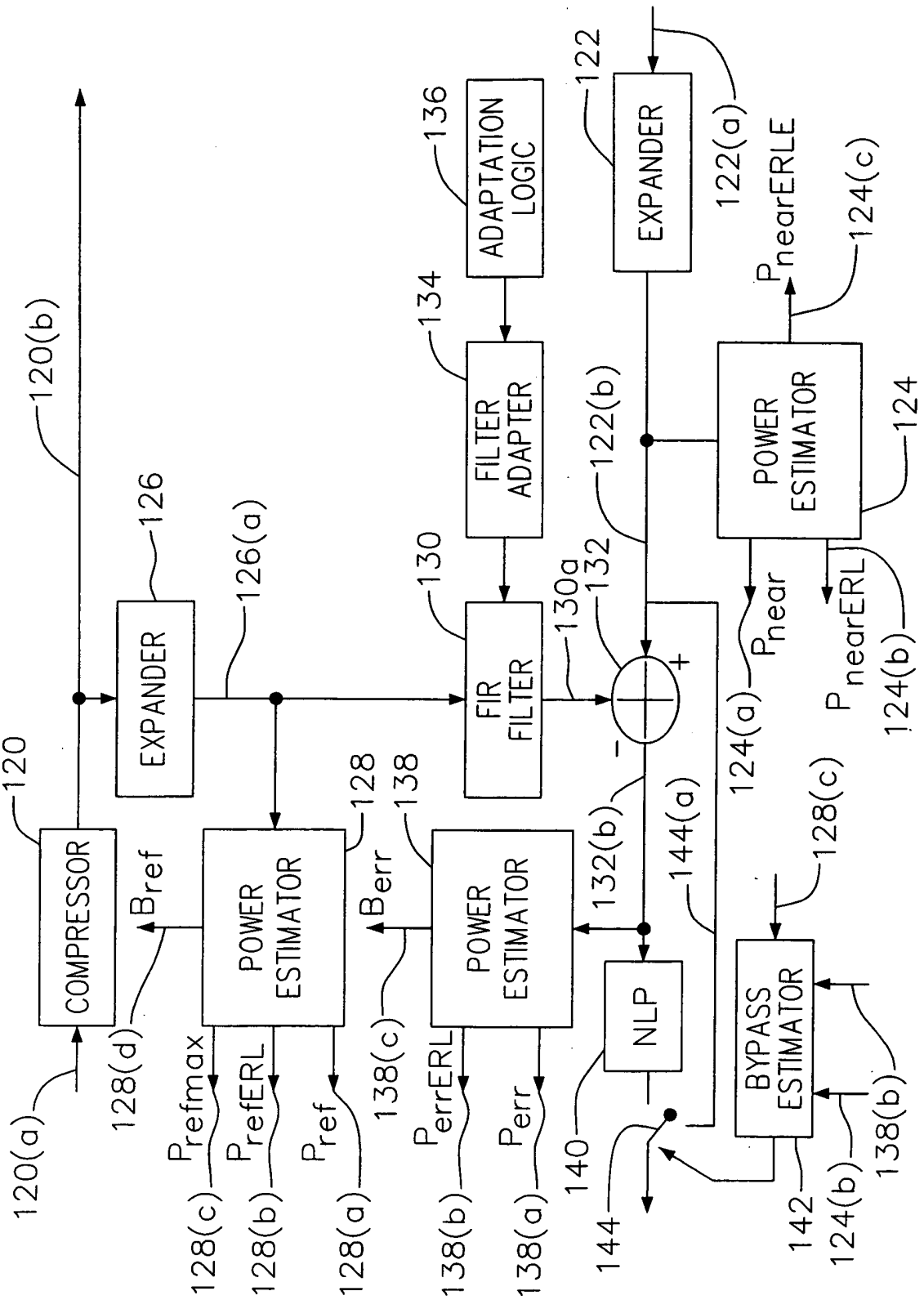

62
CHANNEL
DEPACKETIZING ENGINE
84
86
VOICE QUEUE
87
CALL PROGRESS TONE QUEUE
88
DTMF QUEUE
87(a)
103
CALL PROGRESS TONE ON
90
98(a)
VOICE SYNCHRONIZER
CALL PROGRESS TONE SYNC
102
DTMF SYNC
88(a)
DTMF TONE ON
92
COMFORT NOISE GENERATOR
96
VOICE DECODER
LOST FRAME RECOVERY ENGINE
94
105
CALL PROGRESS TONE GENERATOR
104
TONE GENERATOR
104(a)
100
COMFORT NOISE ESTIMATOR
98
VAD
VOICE PARAMS
106
MEDIA QUEUE
32'
108
GAIN
60(b)
PCM OUT
78
PRE-DEFECT
TONE ON
76
DTMF DETECTOR
DTMF FRAME
68
CALL DISCRIMINATOR
60
PACKETIZATION ENGINE
CALL PROGRESS TONE FRAME
77
CALL PROGRESS TONE DETECTOR
82
VOICE FRAME
VOICE ENCODER
74
AGC
72
NLP
70
ECHO CANCEL
60(a)
PCM IN
SID FRAME
81
COMFORT NOISE ESTIMATOR
VOICE PARAMS
80
VAD
66
MEDIA QUEUE
NLP ON
72(a)
ACT-VE
80a
CHANNEL

FIG. 6

FIG. 7


120(b)
126
126(a)
136
ADAPTATION LOGIC
134
FILTER ADAPTER
122
EXPANDER
122(a)
124(c)
$P_{nearERLE}$
122(b)
POWER ESTIMATOR
124
120
COMPRESSOR
EXPANDER
130
FIR FILTER
130a
132
+
-
P_{near}
$P_{nearERL}$
124(a)
124(b)
B_{ref}
128
POWER ESTIMATOR
B_{err}
138
POWER ESTIMATOR
132(b)
144(a)
128(c)
BYPASS ESTIMATOR
NLP
120(a)
128(d)
P_{refmax}
P_{refERL}
P_{ref}
138(c)
P_{errERL}
P_{err}
140
144
142
124(b)
138(b)
128(c)
128(b)
128(a)
138(b)
138(a)

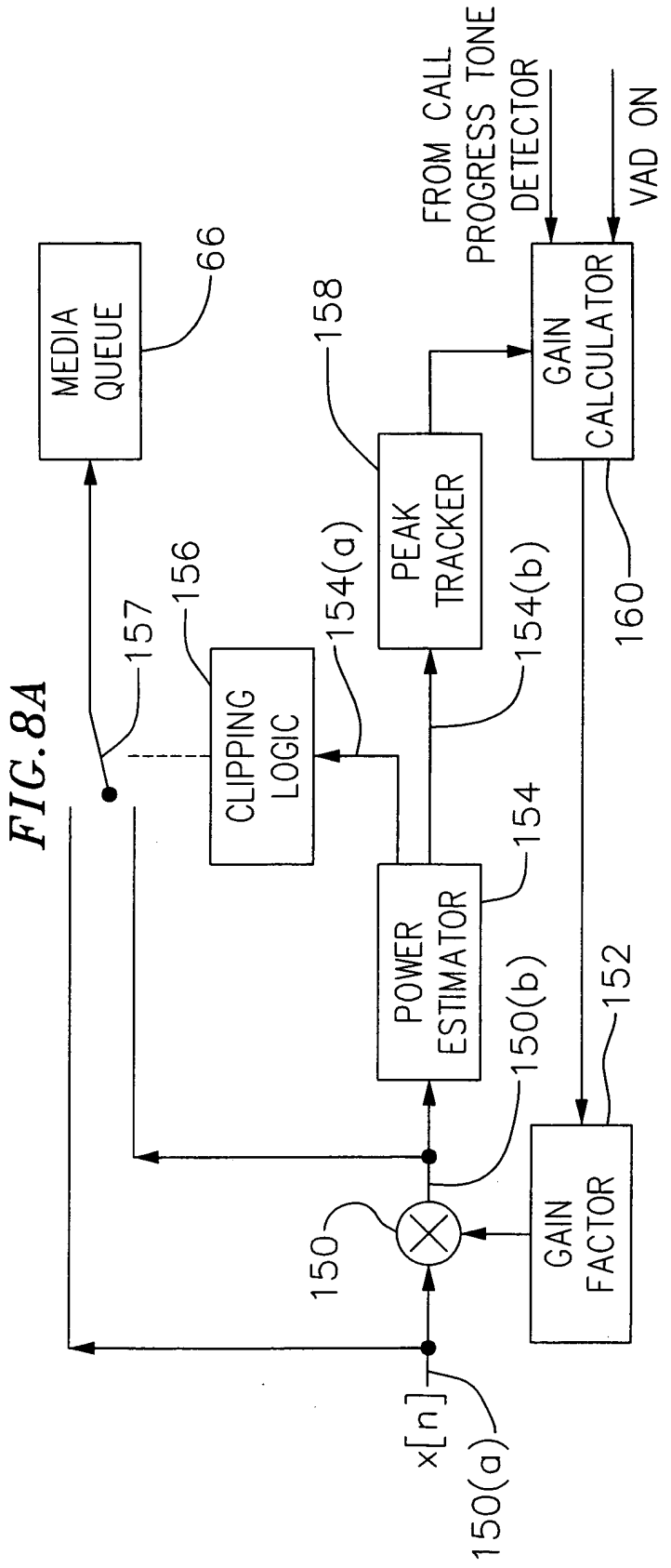

MEDIA QUEUE
66
FROM CALL PROGRESS TONE DETECTOR
VAD ON
158
GAIN CALCULATOR
PEAK TRACKER
154(a)
154(b)
160
157
156
CLIPPING LOGIC
POWER ESTIMATOR
154
150(b)
152
150
GAIN FACTOR
x[n]
150(a)

FIG. 8A

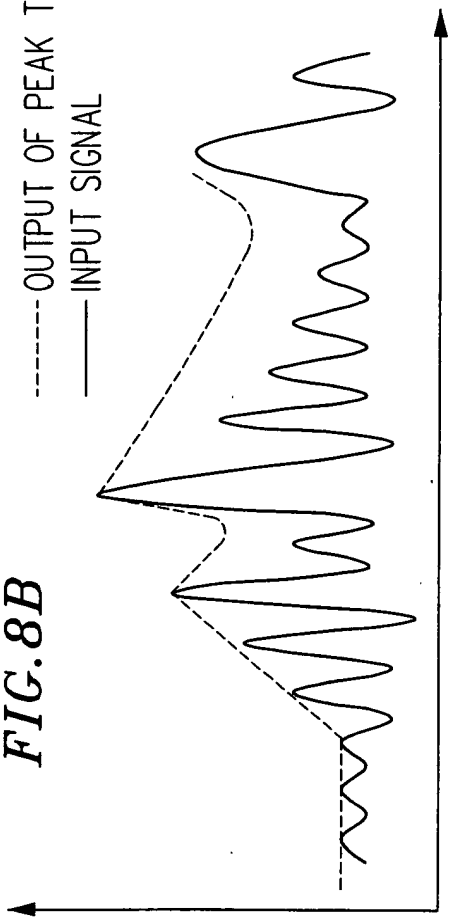
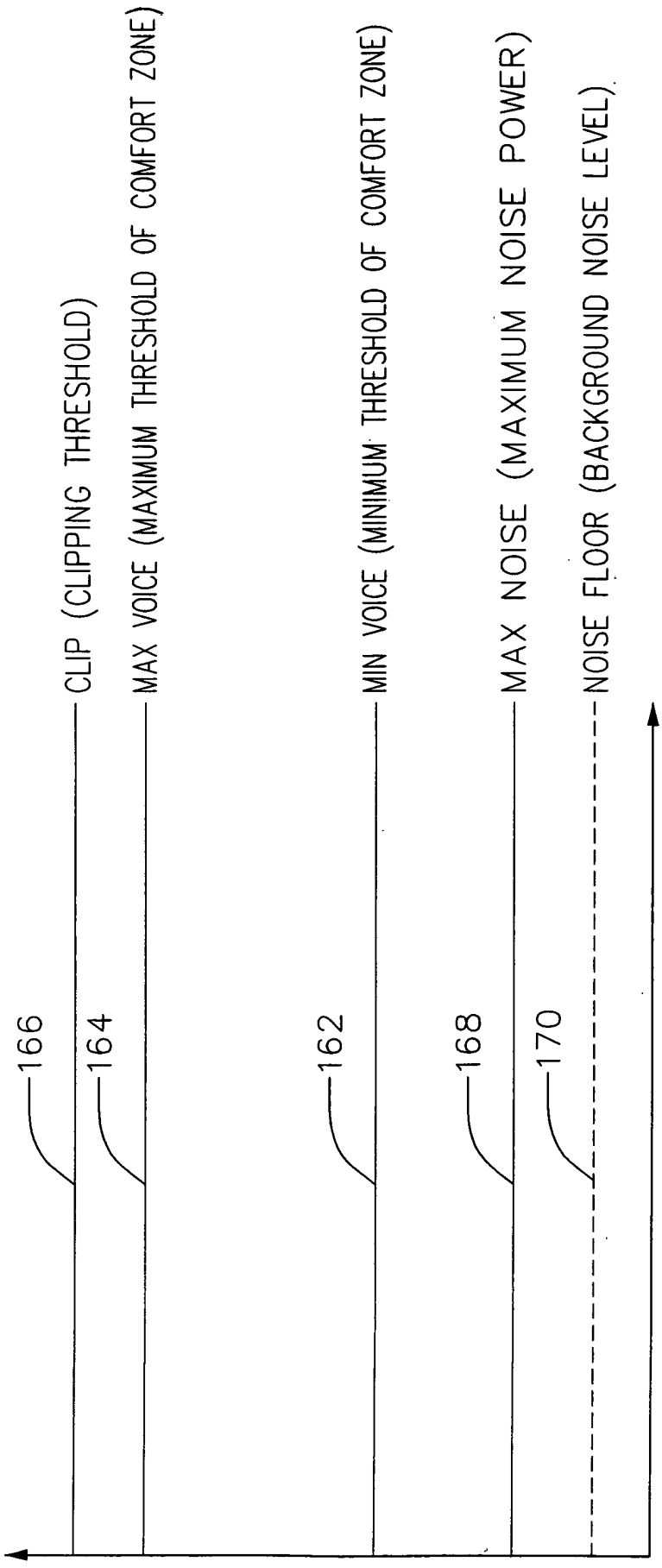

OUTPUT OF PEAK TRACKER
INPUT SIGNAL

FIG. 8B

FIG. 9


CLIP (CLIPPING THRESHOLD)
MAX VOICE (MAXIMUM THRESHOLD OF COMFORT ZONE)
MIN VOICE (MINIMUM THRESHOLD OF COMFORT ZONE)
MAX NOISE (MAXIMUM NOISE POWER)
NOISE FLOOR (BACKGROUND NOISE LEVEL)
166
164
162
168
170

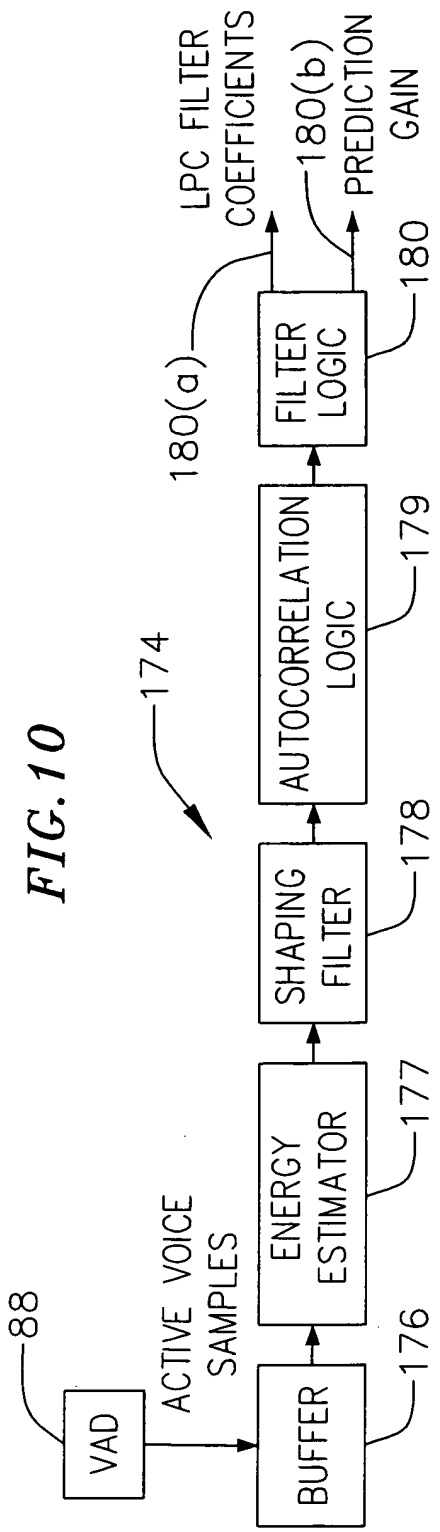

88
VAD
ACTIVE VOICE SAMPLES
BUFFER
176
ENERGY ESTIMATOR
177
SHAPING FILTER
178
AUTOCORRELATION LOGIC
179
FILTER LOGIC
180
180(a)
LPC FILTER COEFFICIENTS
180(b)
PREDICTION GAIN
174

FIG. 10

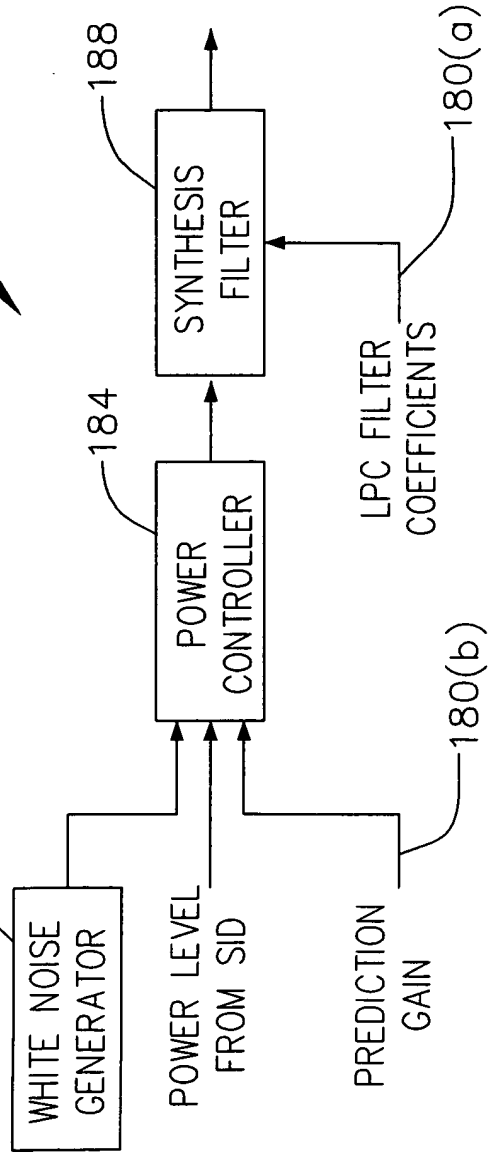

182
186
WHITE NOISE GENERATOR
POWER LEVEL FROM SID
184
POWER CONTROLLER
PREDICTION GAIN
180(b)
188
SYNTHESIS FILTER
LPC FILTER COEFFICIENTS
180(a)

FIG. 11

FIG. 12

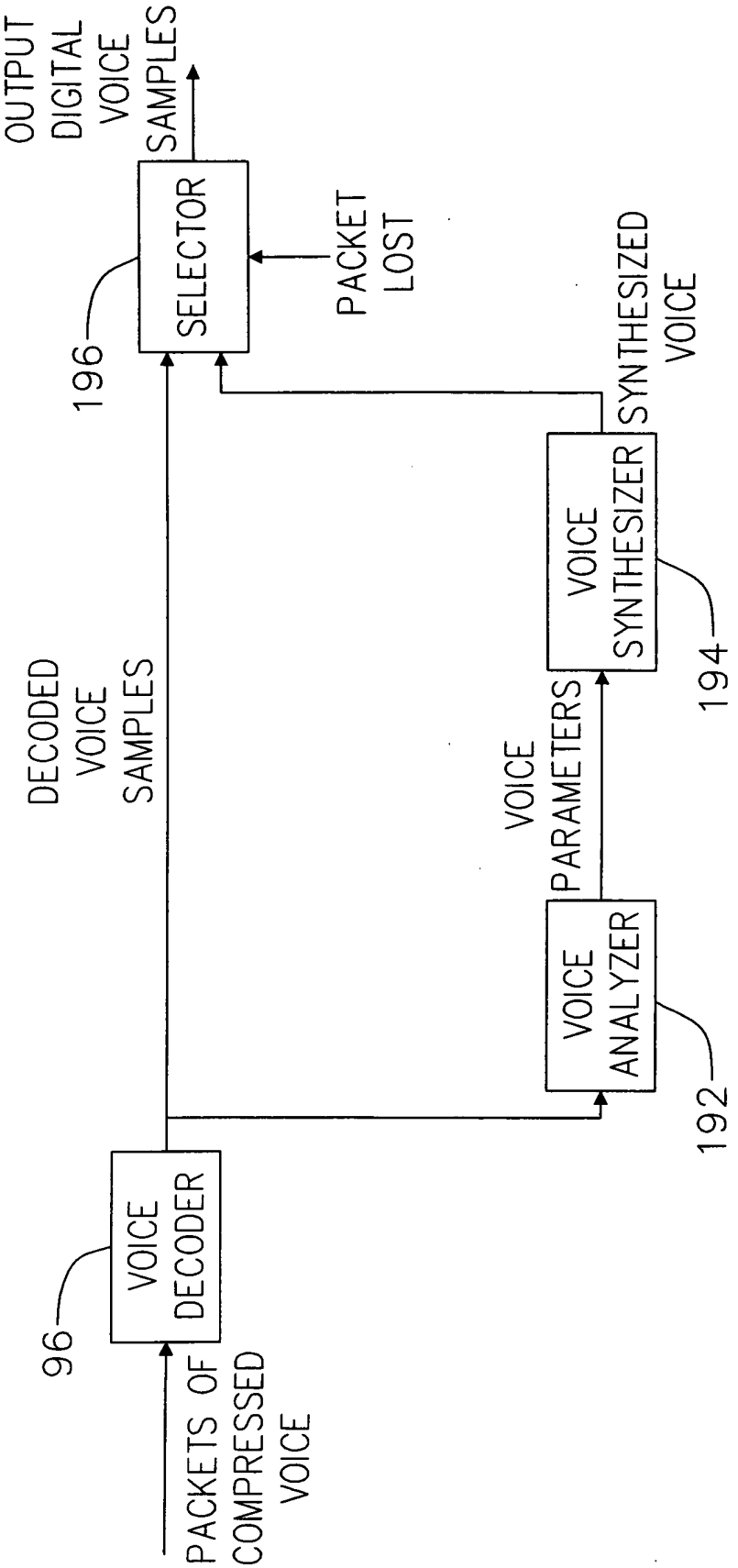

OUTPUT DIGITAL VOICE SAMPLES
SELECTOR
196
PACKET LOST
SYNTHESIZED VOICE
VOICE SYNTHESIZER
194
DECODED VOICE SAMPLES
VOICE PARAMETERS
VOICE ANALYZER
192
VOICE DECODER
96
PACKETS OF COMPRESSED VOICE

FIG. 13A

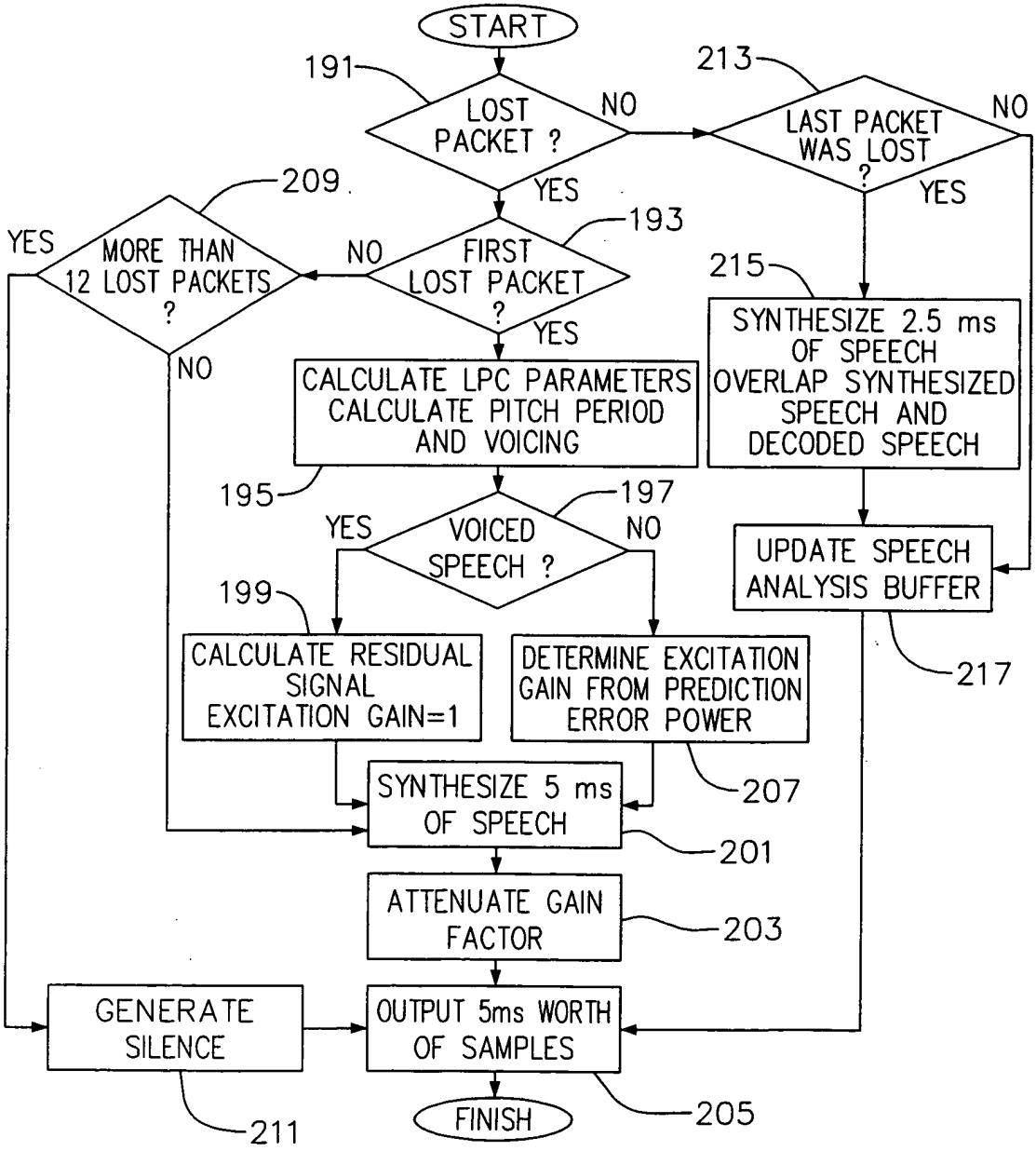

START
191
LOST PACKET ?
NO
YES
213
LAST PACKET WAS LOST ?
NO
YES
209
MORE THAN 12 LOST PACKETS ?
YES
NO
193
FIRST LOST PACKET ?
NO
YES
215
SYNTHESIZE 2.5 ms OF SPEECH OVERLAP SYNTHESIZED SPEECH AND DECODED SPEECH
CALCULATE LPC PARAMETERS CALCULATE PITCH PERIOD AND VOICING
195
197
VOICED SPEECH ?
YES
NO
UPDATE SPEECH ANALYSIS BUFFER
217
199
CALCULATE RESIDUAL SIGNAL EXCITATION GAIN=1
DETERMINE EXCITATION GAIN FROM PREDICTION ERROR POWER
207
SYNTHESIZE 5 ms OF SPEECH
201
ATTENUATE GAIN FACTOR
203
GENERATE SILENCE
OUTPUT 5ms WORTH OF SAMPLES
211
FINISH
205

FIG. 13B

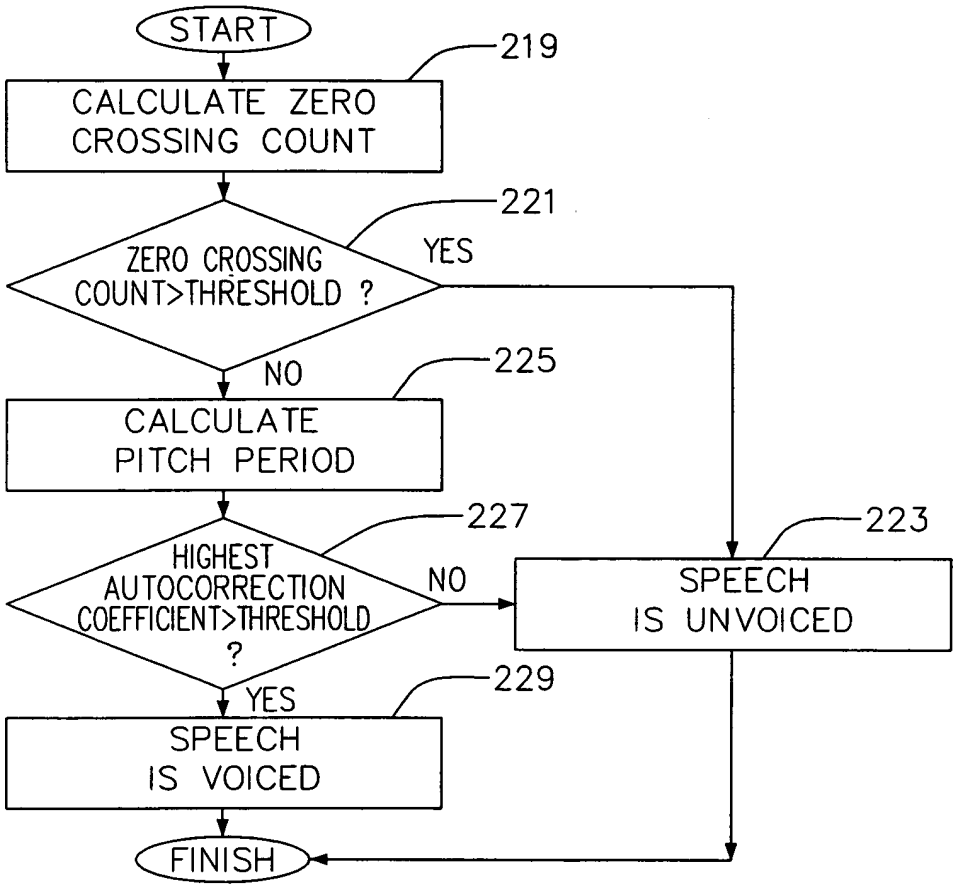

START
219
CALCULATE ZERO CROSSING COUNT
221
ZERO CROSSING COUNT>THRESHOLD ?
YES
NO
225
CALCULATE PITCH PERIOD
227
HIGHEST AUTOCORRECTION COEFFICIENT>THRESHOLD ?
NO
223
SPEECH IS UNVOICED
YES
229
SPEECH IS VOICED
FINISH

FIG. 13C

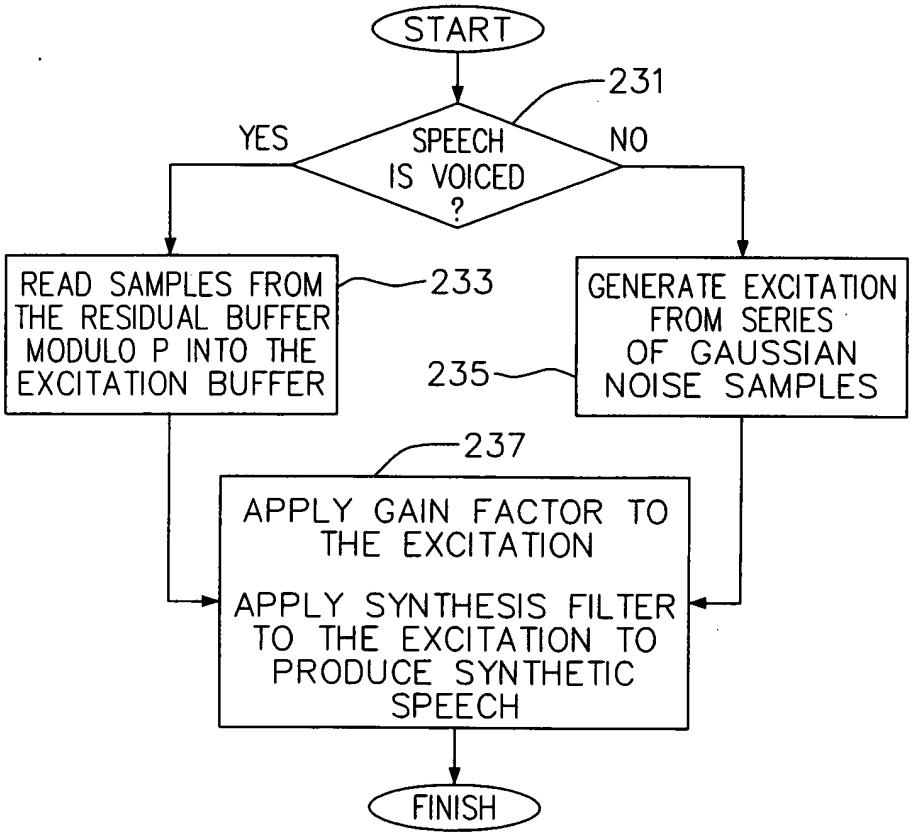

START
231
SPEECH IS VOICED ?
YES
NO
READ SAMPLES FROM THE RESIDUAL BUFFER MODULO P INTO THE EXCITATION BUFFER
233
GENERATE EXCITATION FROM SERIES OF GAUSSIAN NOISE SAMPLES
235
237
APPLY GAIN FACTOR TO THE EXCITATION
APPLY SYNTHESIS FILTER TO THE EXCITATION TO PRODUCE SYNTHETIC SPEECH
FINISH

FIG. 14

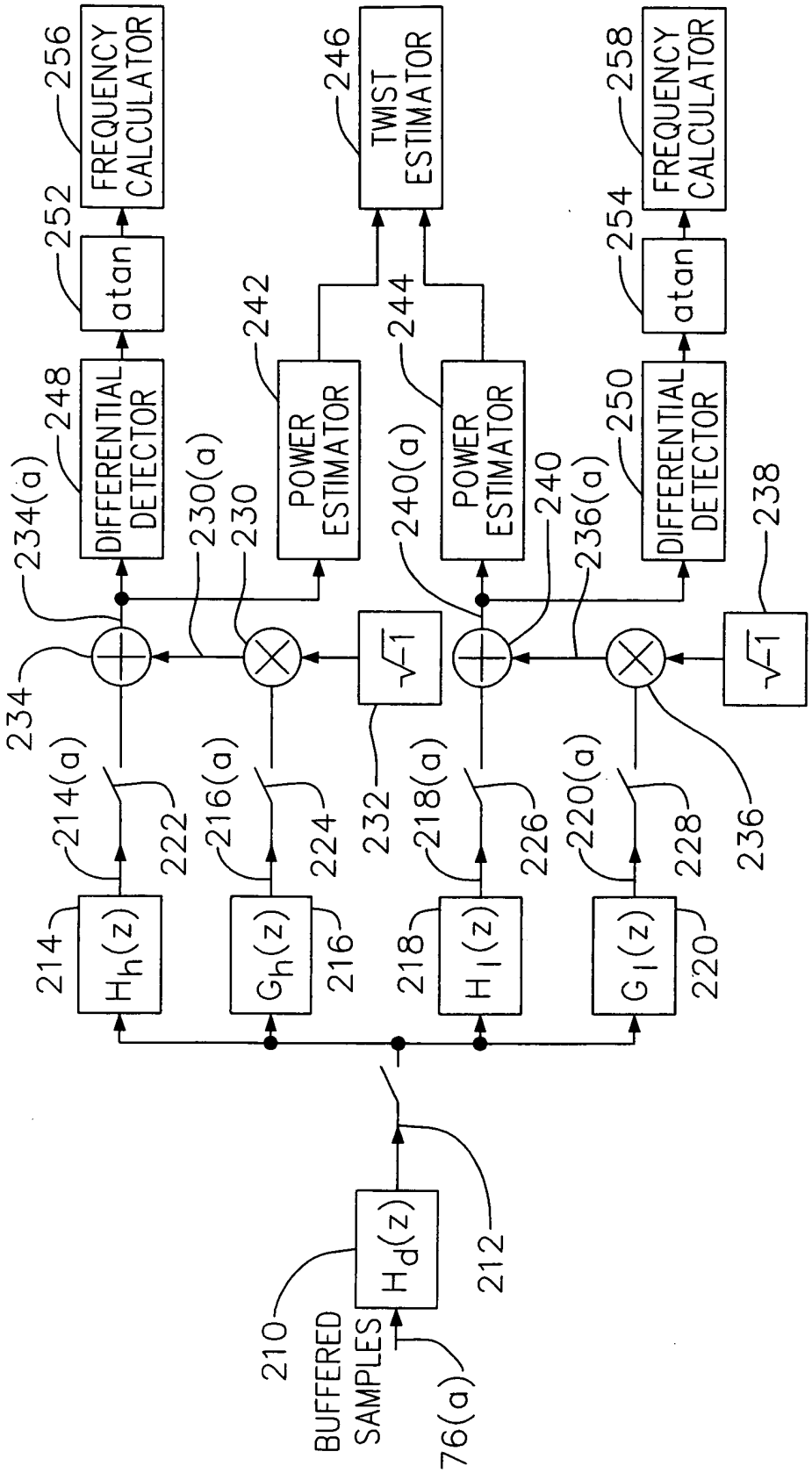

BUFFERED SAMPLES
210
76(a)
$H_d(z)$
212
234
234(a)
214
$H_h(z)$
214(a)
222
216
$G_h(z)$
216(a)
224
218
$H_l(z)$
218(a)
226
220
$G_l(z)$
220(a)
228
230
230(a)
232
$\sqrt{-1}$
236
236(a)
238
$\sqrt{-1}$
240
240(a)
242
POWER ESTIMATOR
244
POWER ESTIMATOR
246
TWIST ESTIMATOR
248
DIFFERENTIAL DETECTOR
250
DIFFERENTIAL DETECTOR
252
atan
254
atan
256
FREQUENCY CALCULATOR
258
FREQUENCY CALCULATOR

FIG. 14A

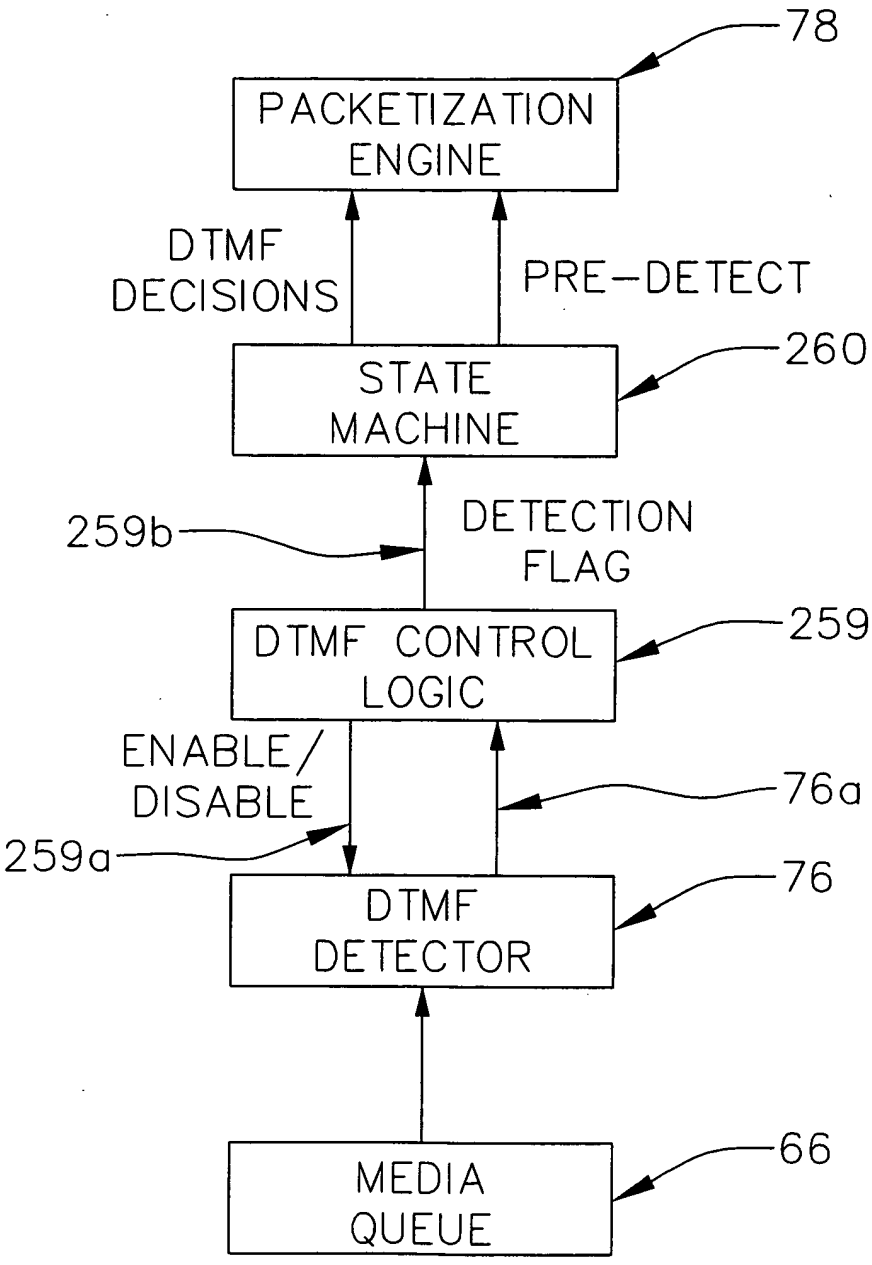
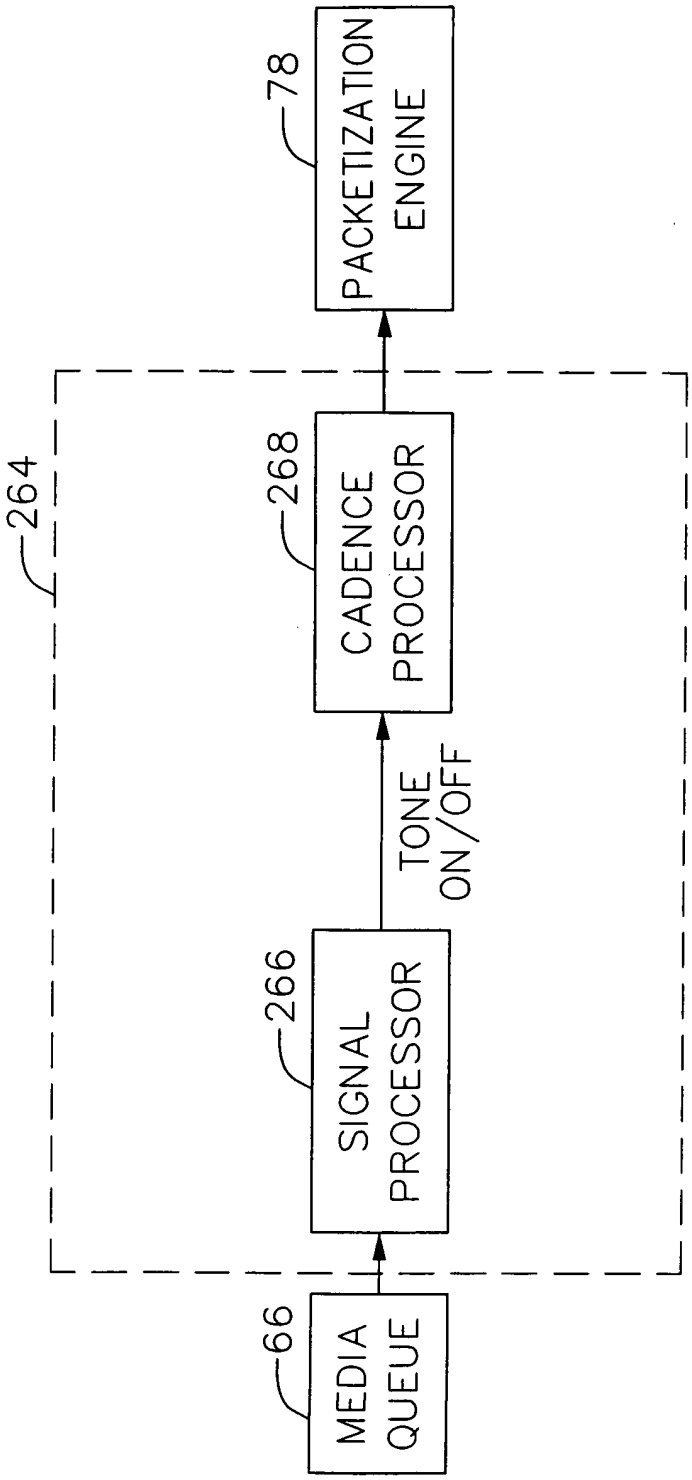

78
PACKETIZATION ENGINE
DTMF DECISIONS
PRE-DETECT
260
STATE MACHINE
259b
DETECTION FLAG
259
DTMF CONTROL LOGIC
ENABLE/ DISABLE
76a
259a
76
DTMF DETECTOR
66
MEDIA QUEUE

FIG. 15


78
PACKETIZATION ENGINE
264
268
CADENCE PROCESSOR
TONE ON/OFF
266
SIGNAL PROCESSOR
66
MEDIA QUEUE

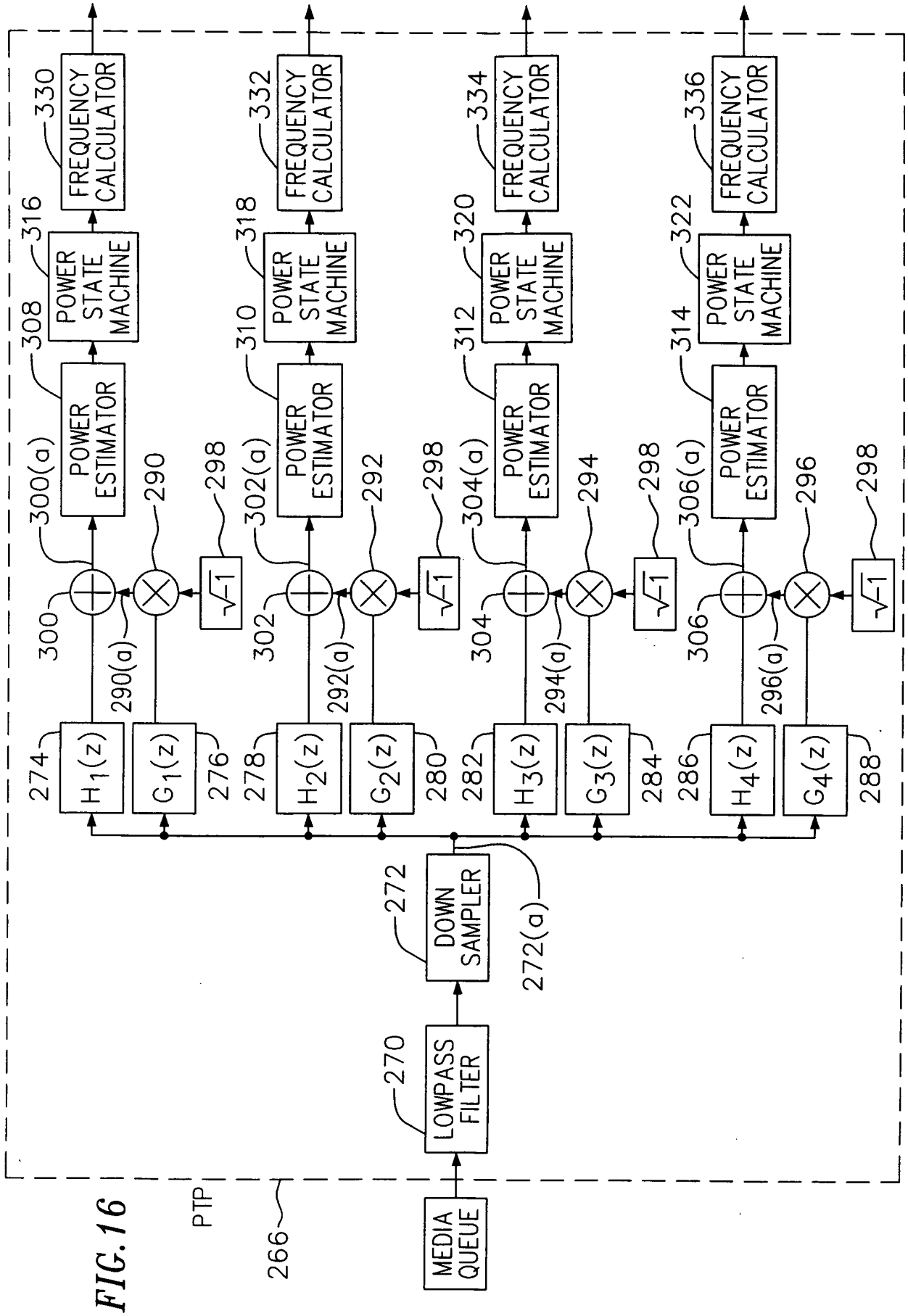

MEDIA QUEUE
266
PTP
LOWPASS FILTER
270
DOWN SAMPLER
272
272(a)
H1(z)
274
G1(z)
276
H2(z)
278
G2(z)
280
H3(z)
282
G3(z)
284
H4(z)
286
G4(z)
288
290
290(a)
292
292(a)
294
294(a)
296
296(a)
298
300
300(a)
302
302(a)
304
304(a)
306
306(a)
POWER ESTIMATOR
308
310
312
314
POWER STATE MACHINE
316
318
320
322
FREQUENCY CALCULATOR
330
332
334
336

FIG. 16

FIG. 17

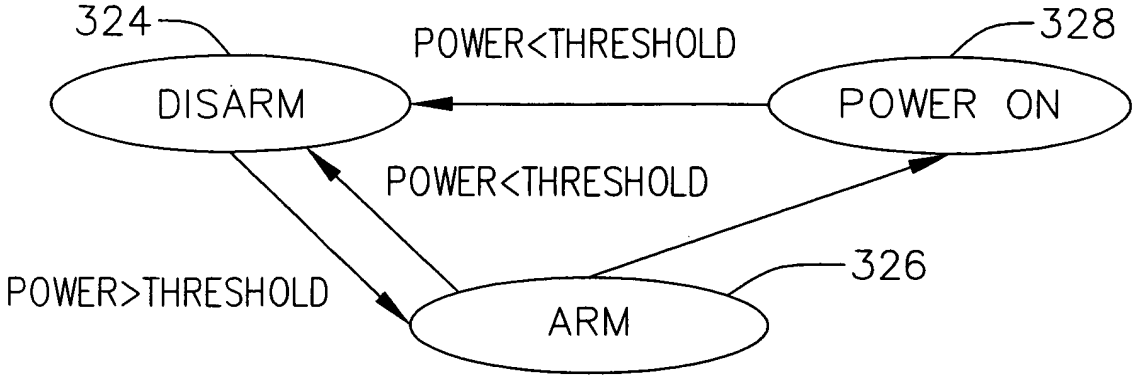

324
POWER<THRESHOLD
328
DISARM
POWER ON
POWER<THRESHOLD
POWER>THRESHOLD
326
ARM

FIG. 18

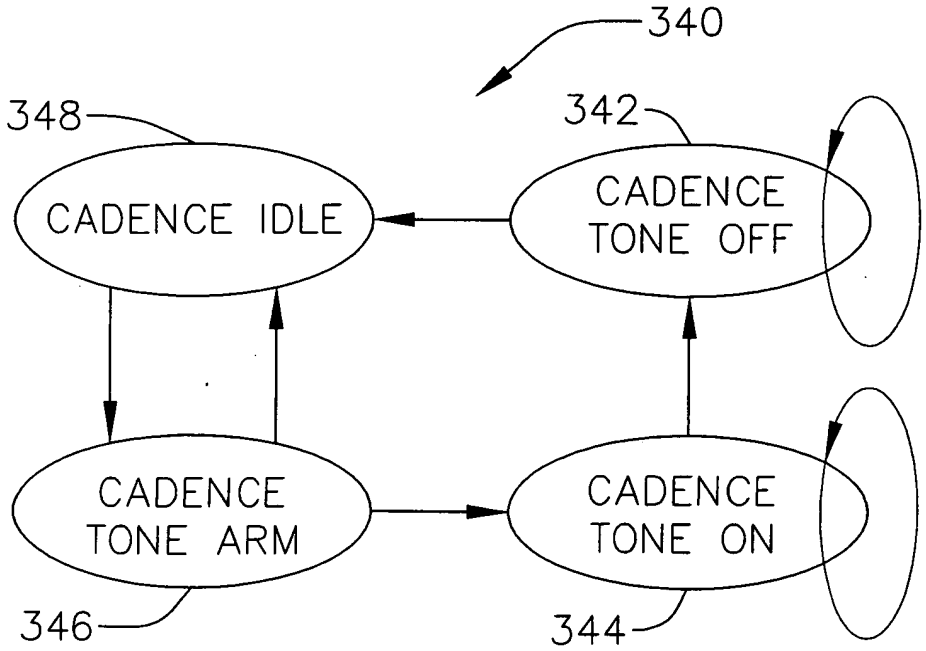

340
348
342
CADENCE IDLE
CADENCE TONE OFF
CADENCE TONE ARM
CADENCE TONE ON
346
344

FIG. 18A

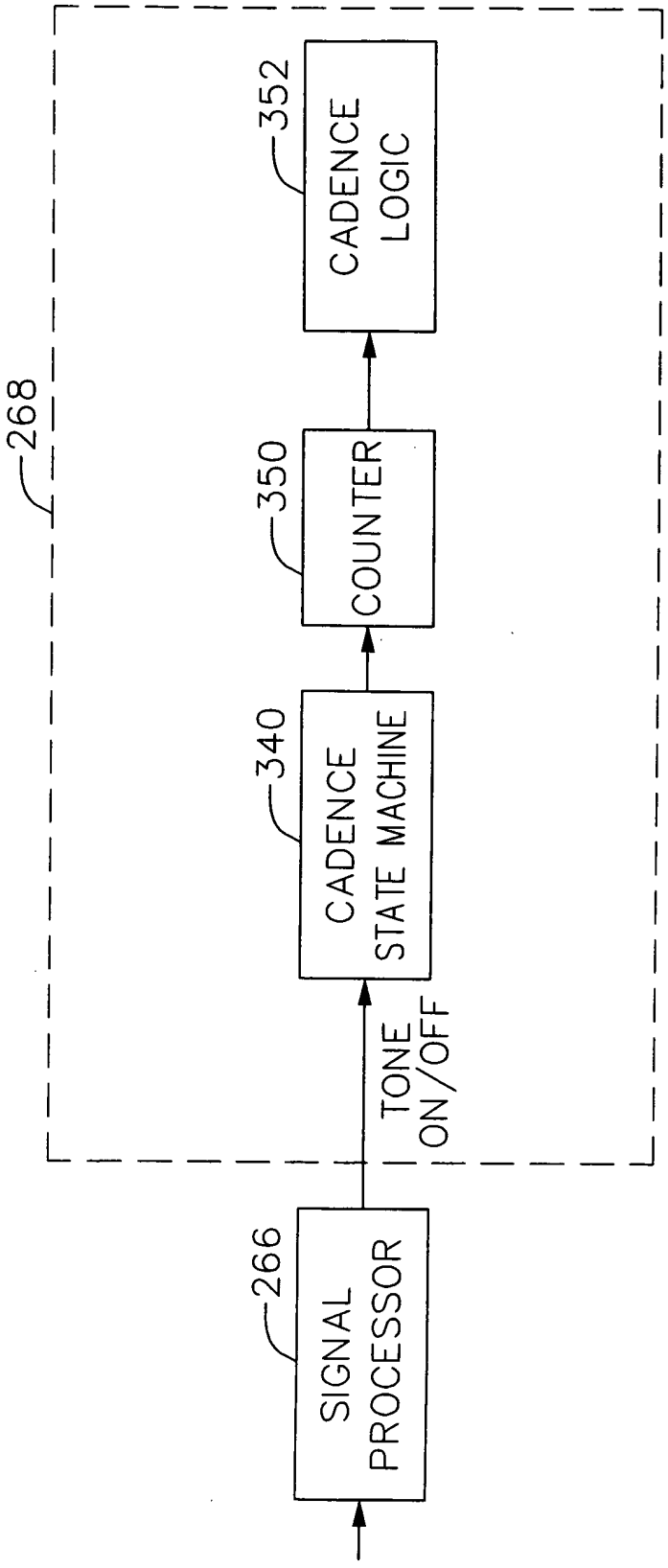
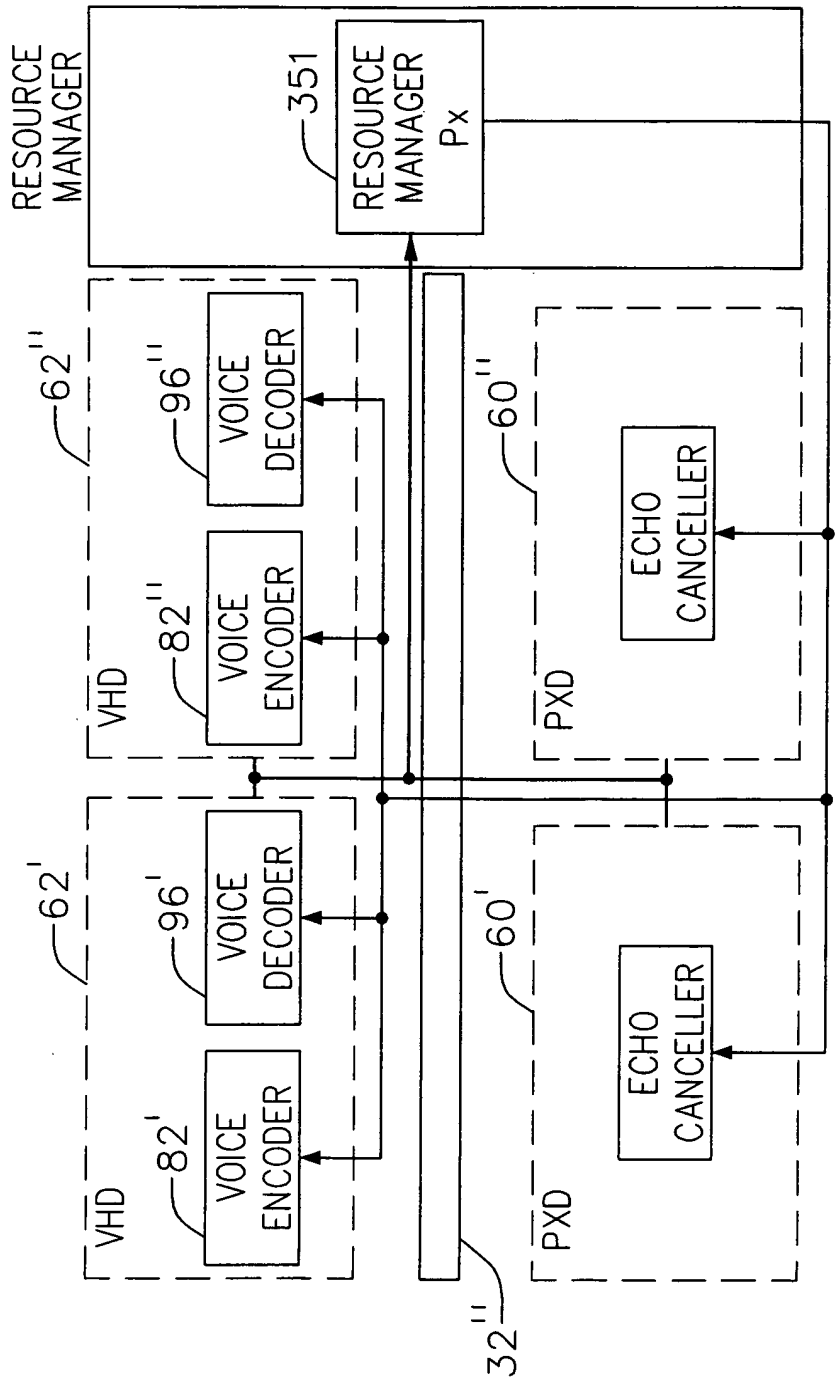

268
352
CADENCE LOGIC
350
COUNTER
340
CADENCE STATE MACHINE
TONE ON/OFF
266
SIGNAL PROCESSOR

FIG. 19


RESOURCE MANAGER
351
RESOURCE MANAGER Px
62''
96''
VOICE DECODER
82''
VOICE ENCODER
VHD
60''
ECHO CANCELLER
PXD
62'
96'
VOICE DECODER
82'
VOICE ENCODER
VHD
60'
ECHO CANCELLER
PXD
32''

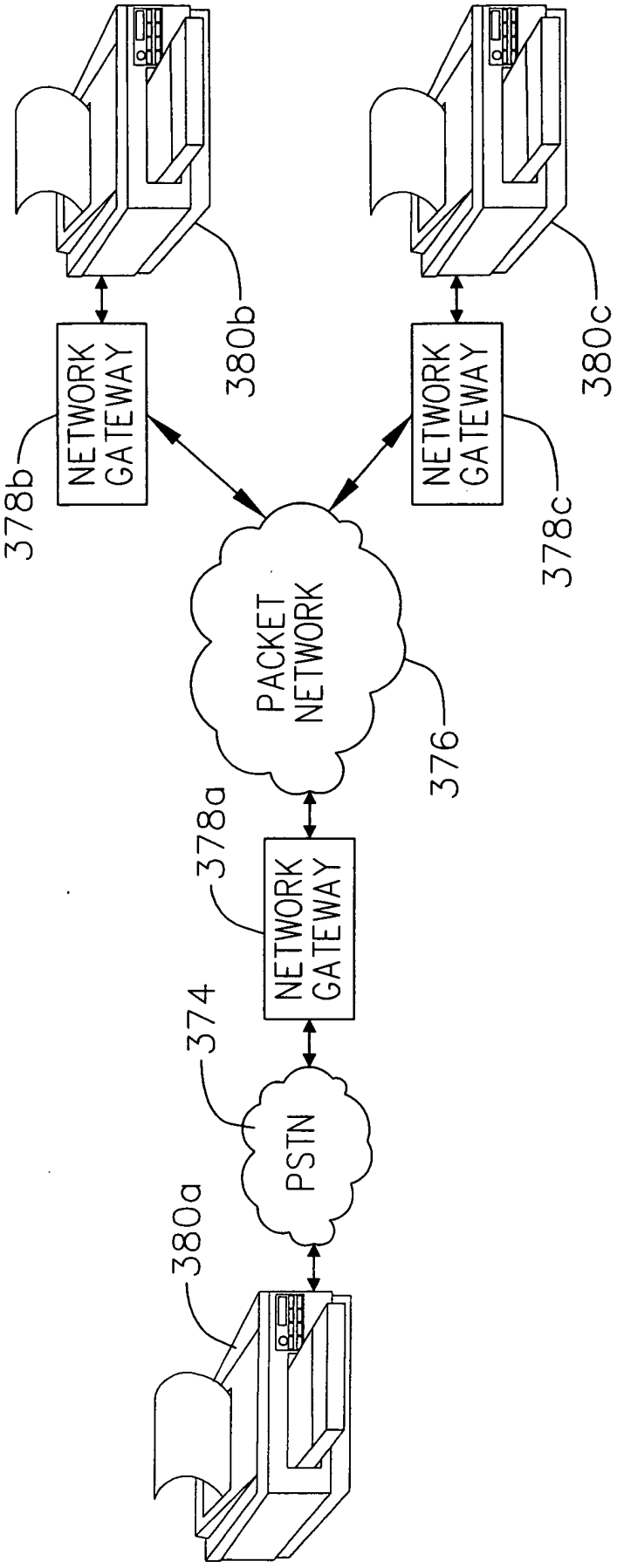

NETWORK GATEWAY
NETWORK GATEWAY
NETWORK GATEWAY
PACKET NETWORK
PSTN
380a
380b
380c
374
376
378a
378b
378c

FIG.20

FIG.21

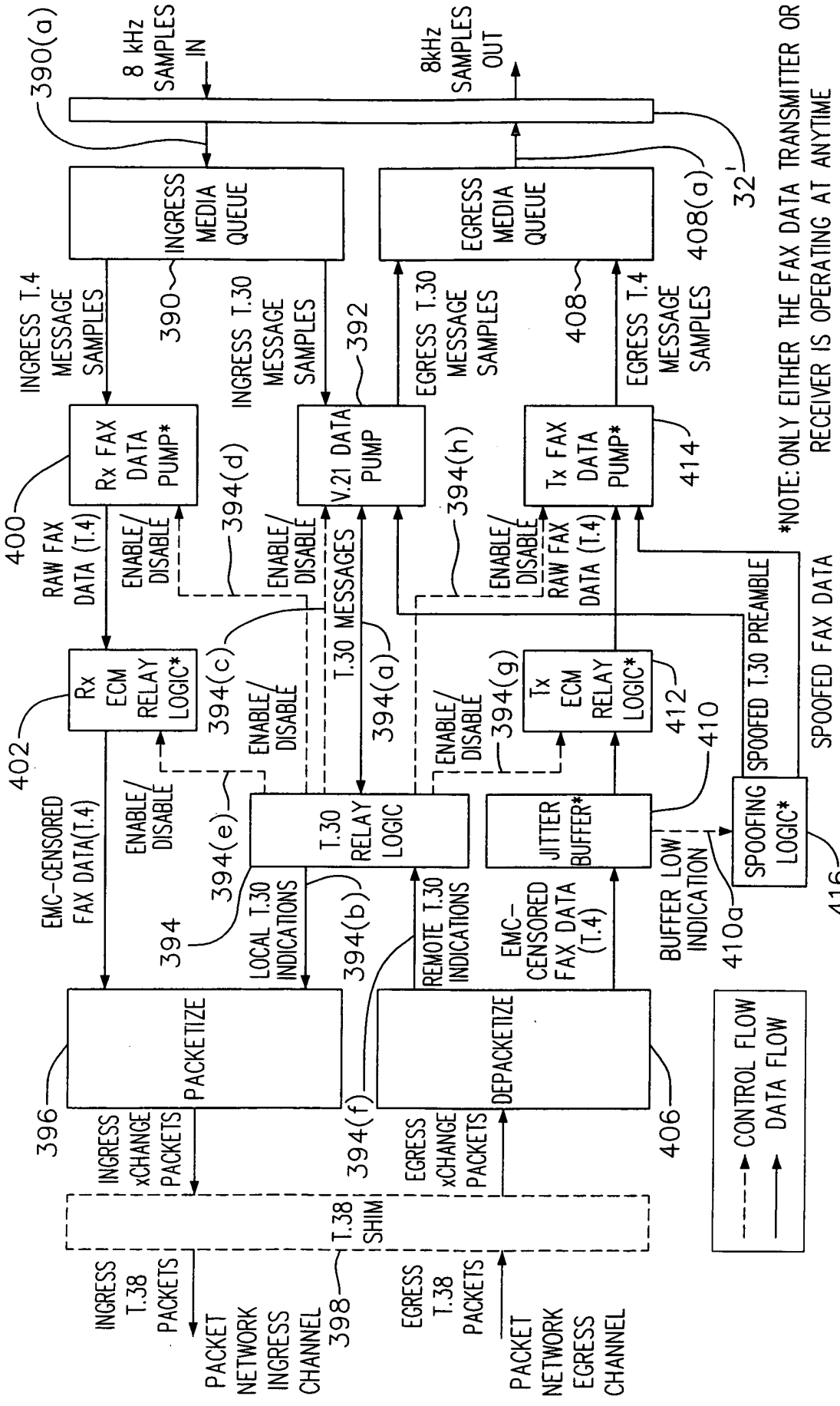

390(a)
8 kHz SAMPLES IN
8kHz SAMPLES OUT
INGRESS MEDIA QUEUE
EGRESS MEDIA QUEUE
32'
408(a)
INGRESS T.4 MESSAGE SAMPLES
390
INGRESS T.30 MESSAGE SAMPLES
392
EGRESS T.30 MESSAGE SAMPLES
408
EGRESS T.4 MESSAGE SAMPLES
Rx FAX DATA PUMP*
V.21 DATA PUMP
Tx FAX DATA PUMP*
414
400
RAW FAX DATA (T.4)
ENABLE/ DISABLE
394(d)
394(h)
394(c)
T.30 MESSAGES
394(a)
394(g)
Rx ECM RELAY LOGIC*
Tx ECM RELAY LOGIC*
412
402
410
*NOTE: ONLY EITHER THE FAX DATA TRANSMITTER OR RECEIVER IS OPERATING AT ANYTIME
SPOOFED T.30 PREAMBLE
SPOOFED FAX DATA
394(e)
T.30 RELAY LOGIC
JITTER BUFFER*
SPOOFING LOGIC*
416
EMC-CENSORED FAX DATA(T.4)
394
LOCAL T.30 INDICATIONS
394(b)
REMOTE T.30 INDICATIONS
EMC-CENSORED FAX DATA (T.4)
BUFFER LOW INDICATION
410a
396
PACKETIZE
DEPACKETIZE
406
394(f)
INGRESS xCHANGE PACKETS
EGRESS xCHANGE PACKETS
T.38 SHIM
INGRESS T.38 PACKETS
EGRESS T.38 PACKETS
PACKET NETWORK INGRESS CHANNEL
398
PACKET NETWORK EGRESS CHANNEL
CONTROL FLOW
DATA FLOW

FIG.22

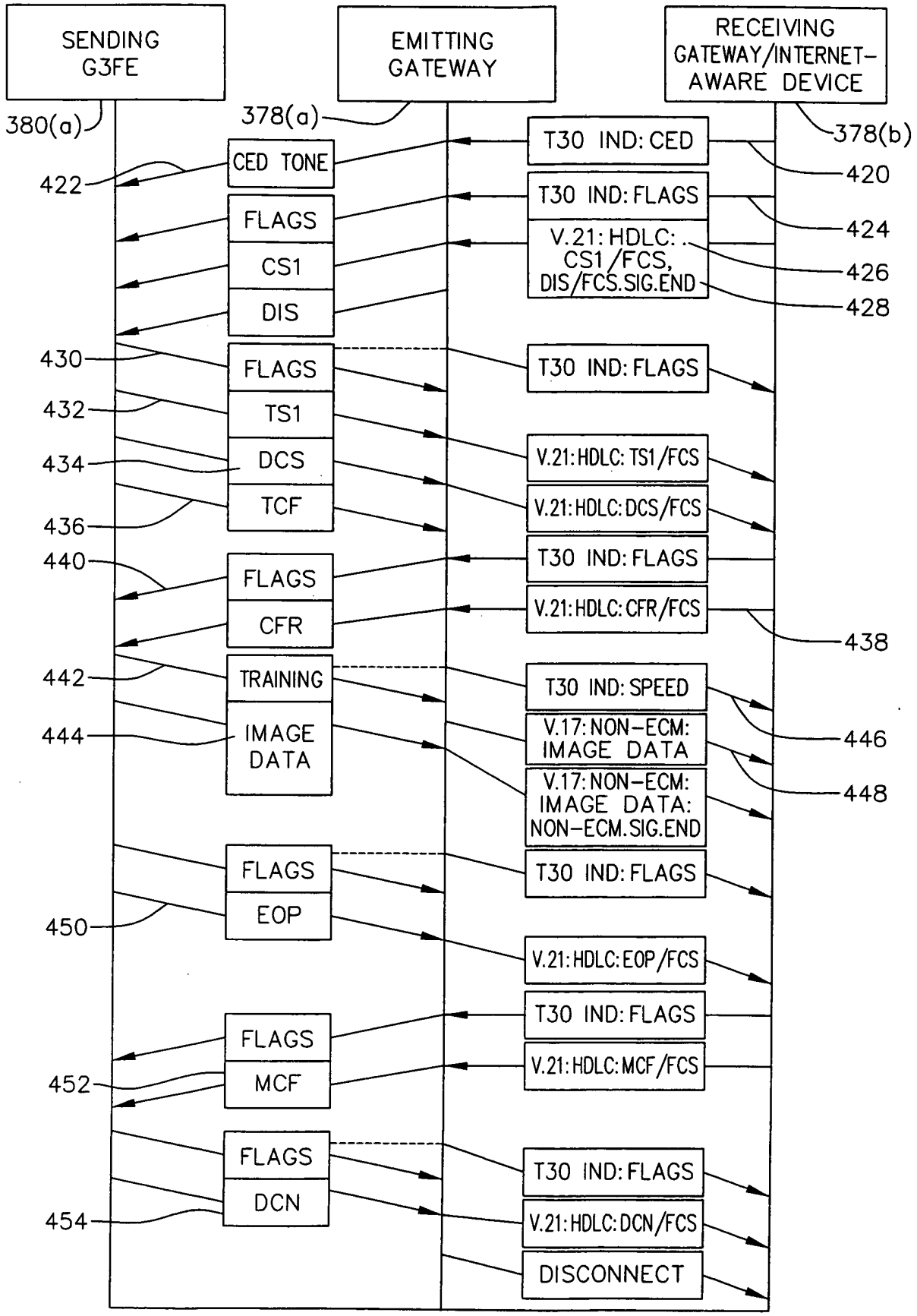
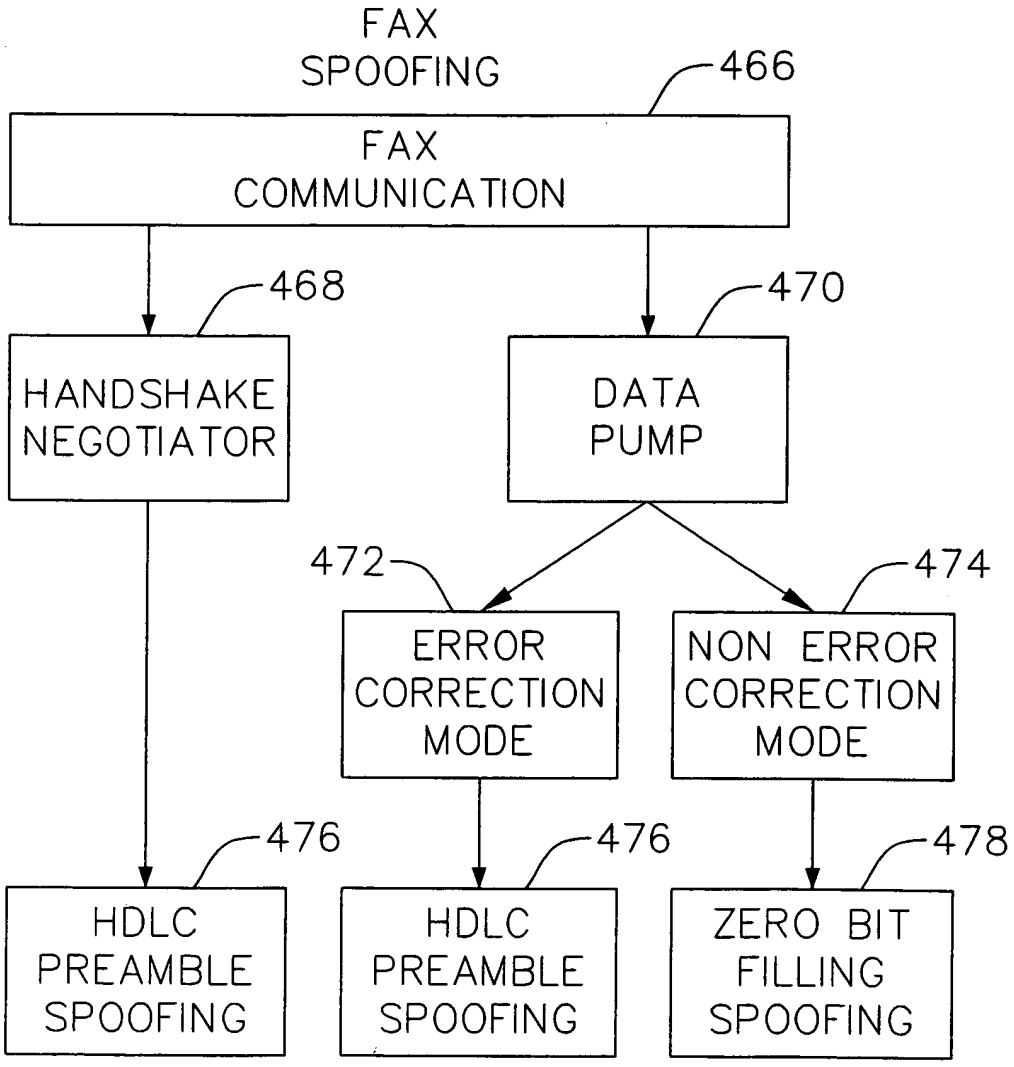

SENDING G3FE
EMITTING GATEWAY
RECEIVING GATEWAY/INTERNET-AWARE DEVICE
380(a)
378(a)
378(b)
CED TONE
422
T30 IND: CED
420
FLAGS
CS1
DIS
T30 IND: FLAGS
V.21: HDLC: .. CS1/FCS, DIS/FCS.SIG.END
424
426
428
430
FLAGS
T30 IND: FLAGS
432
TS1
V.21: HDLC: TS1/FCS
434
DCS
V.21: HDLC: DCS/FCS
TCF
436
440
FLAGS
T30 IND: FLAGS
CFR
V.21: HDLC: CFR/FCS
438
442
TRAINING
T30 IND: SPEED
444
IMAGE DATA
V.17: NON-ECM: IMAGE DATA
446
V.17: NON-ECM: IMAGE DATA: NON-ECM.SIG.END
448
FLAGS
T30 IND: FLAGS
EOP
450
V.21: HDLC: EOP/FCS
T30 IND: FLAGS
FLAGS
MCF
452
V.21: HDLC: MCF/FCS
FLAGS
T30 IND: FLAGS
DCN
454
V.21: HDLC: DCN/FCS
DISCONNECT

FIG.23


FAX SPOOFING
466
FAX COMMUNICATION
468
470
HANDSHAKE NEGOTIATOR
DATA PUMP
472
474
ERROR CORRECTION MODE
NON ERROR CORRECTION MODE
476
476
478
HDLC PREAMBLE SPOOFING
HDLC PREAMBLE SPOOFING
ZERO BIT FILLING SPOOFING

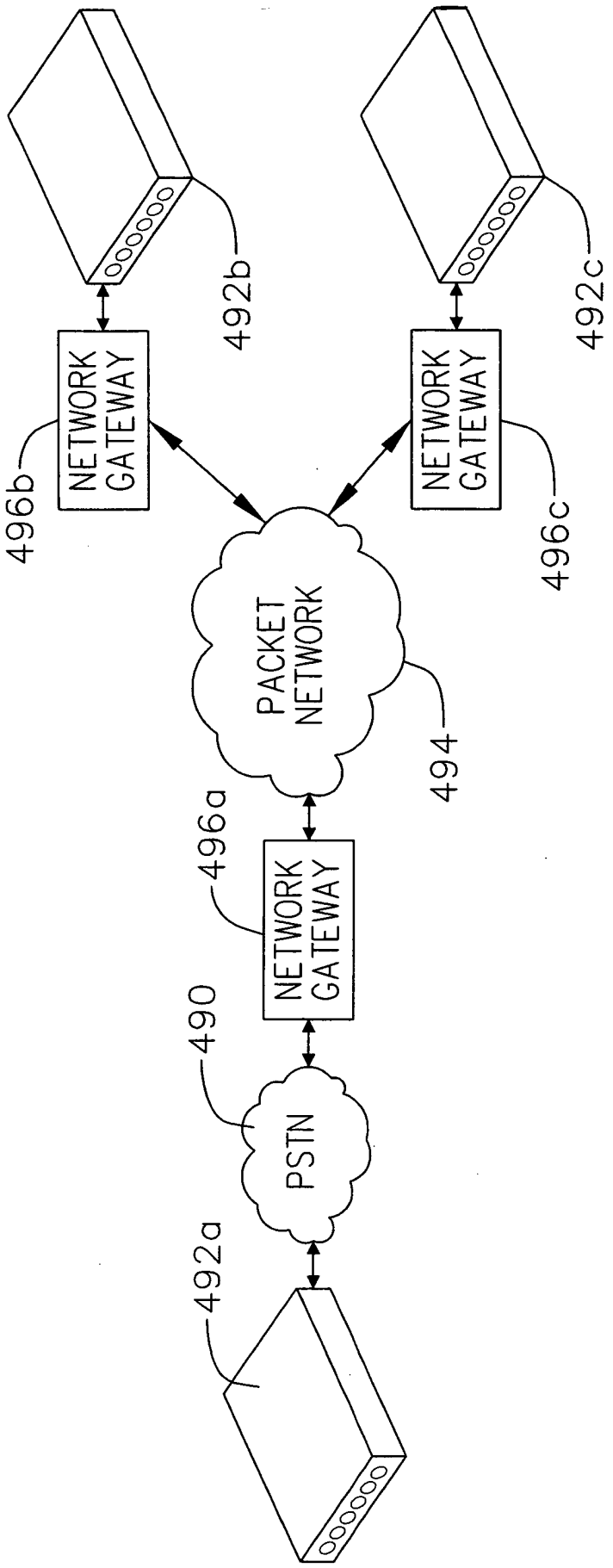

492b
492c
NETWORK GATEWAY
NETWORK GATEWAY
496b
496c
PACKET NETWORK
494
496a
NETWORK GATEWAY
490
PSTN
492a

FIG. 24

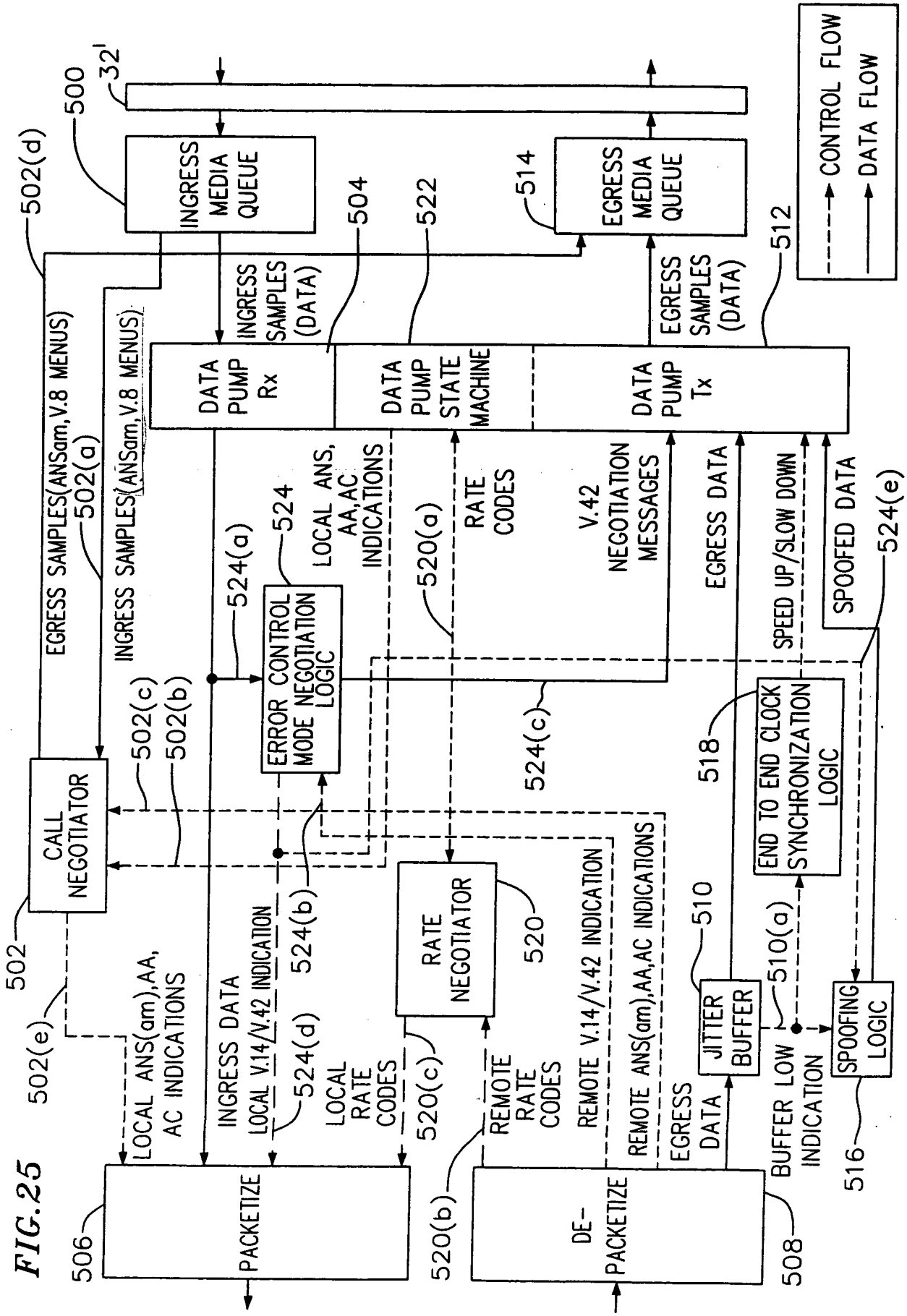

CONTROL FLOW
DATA FLOW
INGRESS MEDIA QUEUE
EGRESS MEDIA QUEUE
INGRESS SAMPLES (DATA)
EGRESS SAMPLES (DATA)
DATA PUMP Rx
DATA PUMP STATE MACHINE
DATA PUMP Tx
EGRESS SAMPLES(ANSam,V.8 MENUS)
INGRESS SAMPLES(ANSam,V.8 MENUS)
LOCAL ANS, AA,AC INDICATIONS
RATE CODES
V.42 NEGOTIATION MESSAGES
EGRESS DATA
SPEED UP/SLOW DOWN
SPOOFED DATA
ERROR CONTROL MODE NEGOTIATION LOGIC
CALL NEGOTIATOR
RATE NEGOTIATOR
END TO END CLOCK SYNCHRONIZATION LOGIC
JITTER BUFFER
SPOOFING LOGIC
LOCAL ANS(am),AA, AC INDICATIONS
INGRESS DATA
LOCAL V.14/V.42 INDICATION
LOCAL RATE CODES
REMOTE RATE CODES
REMOTE V.14/V.42 INDICATION
REMOTE ANS(am),AA,AC INDICATIONS
EGRESS DATA
BUFFER LOW INDICATION
PACKETIZE
DE-PACKETIZE
500
502
502(a)
502(b)
502(c)
502(d)
502(e)
504
506
508
510
510(a)
512
514
516
518
520
520(a)
520(b)
520(c)
522
524
524(a)
524(b)
524(c)
524(d)
524(e)

FIG. 25

FIG. 26

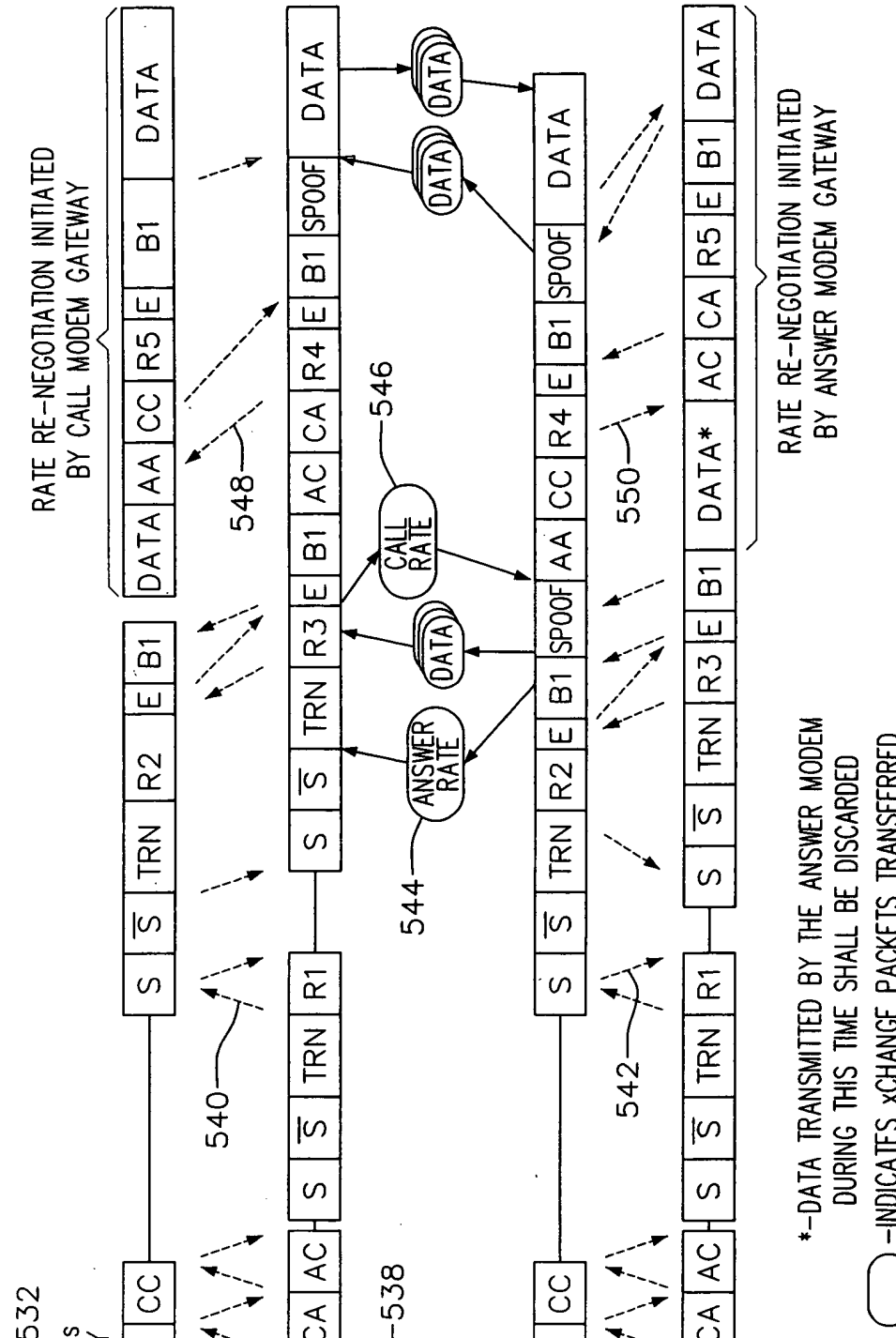

CALL DISCRIMINATOR/ CALL NEGOTIATOR
V.32bis RELAY
532
CALL MODEM
CALL MODEM GATEWAY
ANSWER MODEM GATEWAY
ANSWER MODEM
492(a)
496(a)
496(b)
492(b)
530
534
538
540
542
544
546
548
550
536
ANS(am)
AA
AC
CC
CA
S
TRN
R1
R2
R3
R4
R5
E
B1
SPOOF
DATA
DATA*
ANSWER RATE
CALL RATE
RATE RE-NEGOTIATION INITIATED BY CALL MODEM GATEWAY
RATE RE-NEGOTIATION INITIATED BY ANSWER MODEM GATEWAY
*-DATA TRANSMITTED BY THE ANSWER MODEM DURING THIS TIME SHALL BE DISCARDED
-INDICATES xCHANGE PACKETS TRANSFERRED ACROSS THE NETWORK

FIG. 27

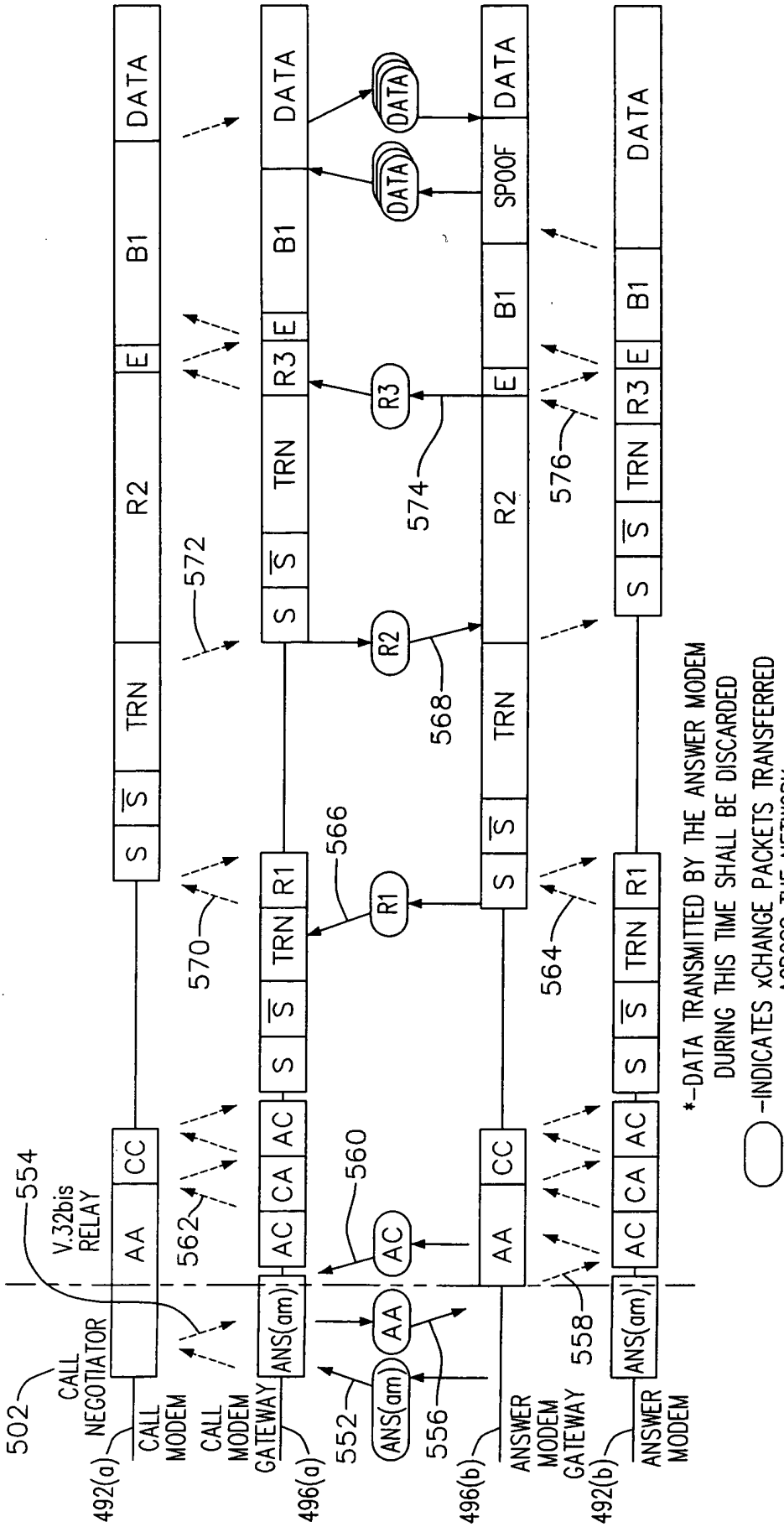

502
CALL NEGOTIATOR
554
V.32bis RELAY
492(a)
CALL MODEM
CALL MODEM GATEWAY
496(a)
552
ANS(am)
AA
556
ANSWER MODEM GATEWAY
496(b)
ANSWER MODEM
492(b)
558
560
562
564
566
568
570
572
574
576
S
S̄
TRN
R1
R2
R3
E
B1
DATA
SPOOF
AC
CA
AA
CC
*-DATA TRANSMITTED BY THE ANSWER MODEM DURING THIS TIME SHALL BE DISCARDED
-INDICATES xCHANGE PACKETS TRANSFERRED ACROSS THE NETWORK

FIG. 28

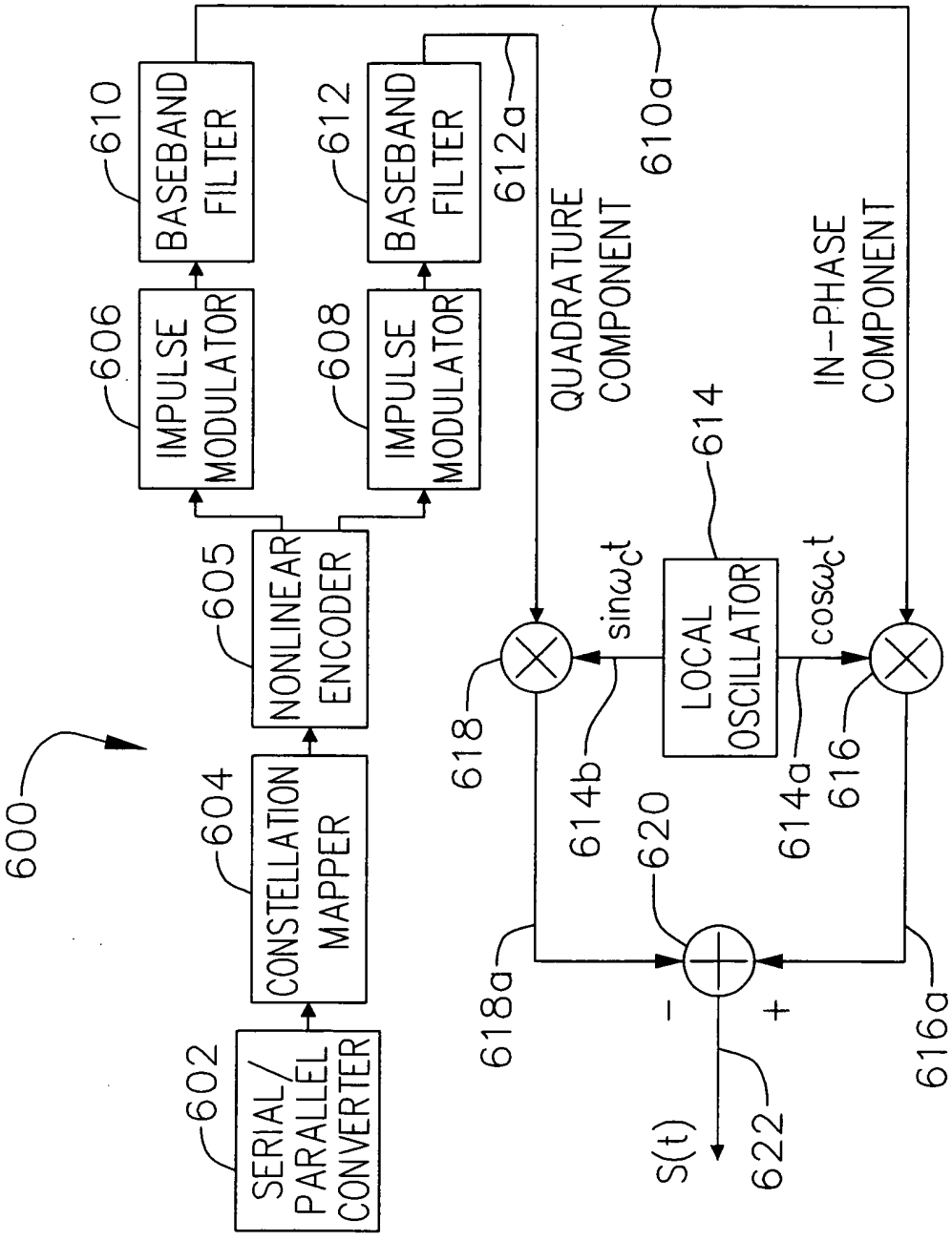

600
602
SERIAL/ PARALLEL CONVERTER
604
CONSTELLATION MAPPER
605
NONLINEAR ENCODER
606
IMPULSE MODULATOR
608
IMPULSE MODULATOR
610
BASEBAND FILTER
612
BASEBAND FILTER
610a
612a
QUADRATURE COMPONENT
IN-PHASE COMPONENT
614
LOCAL OSCILLATOR
sinωct
cosωct
618
614b
614a
616
620
618a
616a
S(t)
622
-
+

FIG. 29

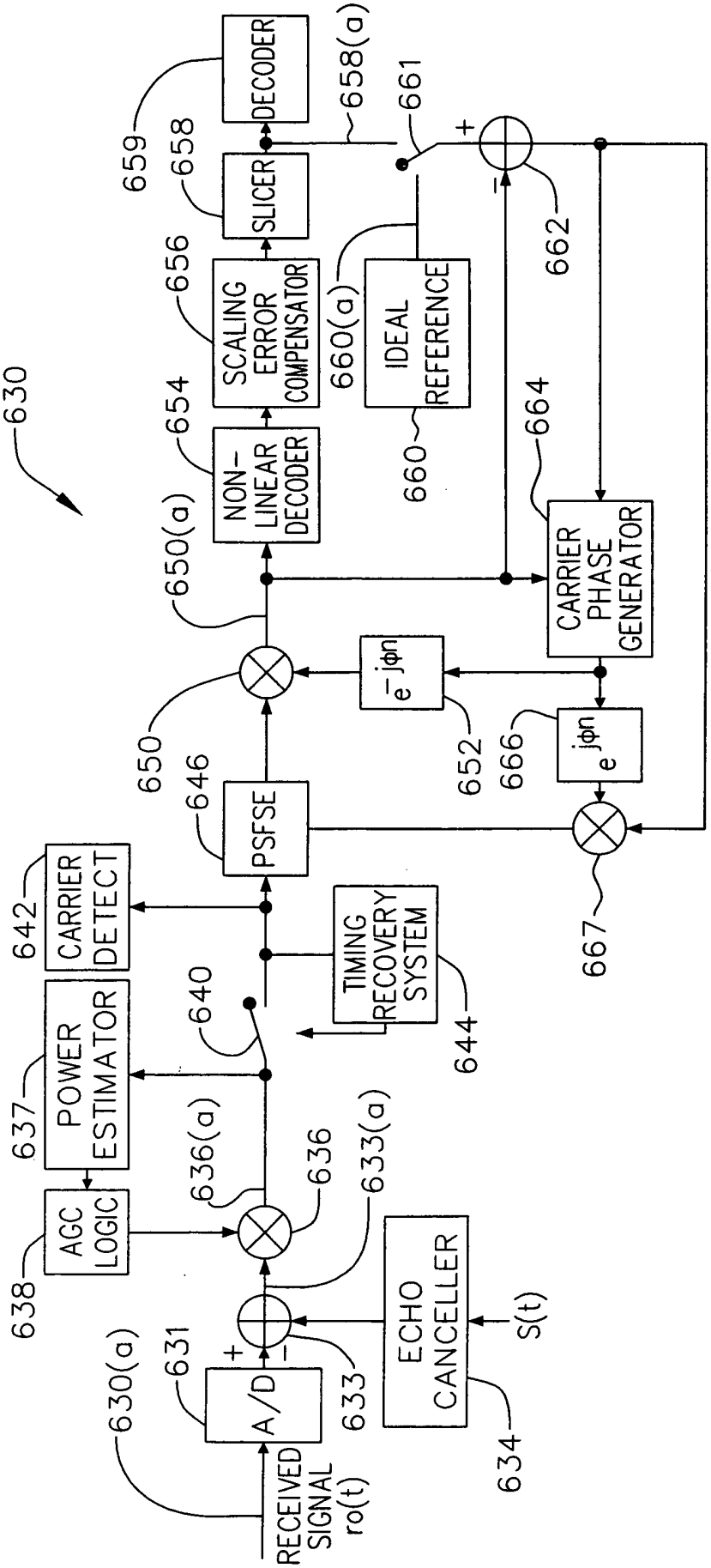

630
630(a)
RECEIVED SIGNAL ro(t)
631
A/D
633
634
ECHO CANCELLER
S(t)
633(a)
636
636(a)
638
AGC LOGIC
637
POWER ESTIMATOR
640
642
CARRIER DETECT
644
TIMING RECOVERY SYSTEM
646
PSFSE
650
650(a)
652
$e^{-j\phi n}$
654
NON-LINEAR DECODER
656
SCALING ERROR COMPENSATOR
658
SLICER
659
DECODER
658(a)
660
660(a)
IDEAL REFERENCE
661
662
664
CARRIER PHASE GENERATOR
666
$e^{j\phi n}$
667

FIG. 30

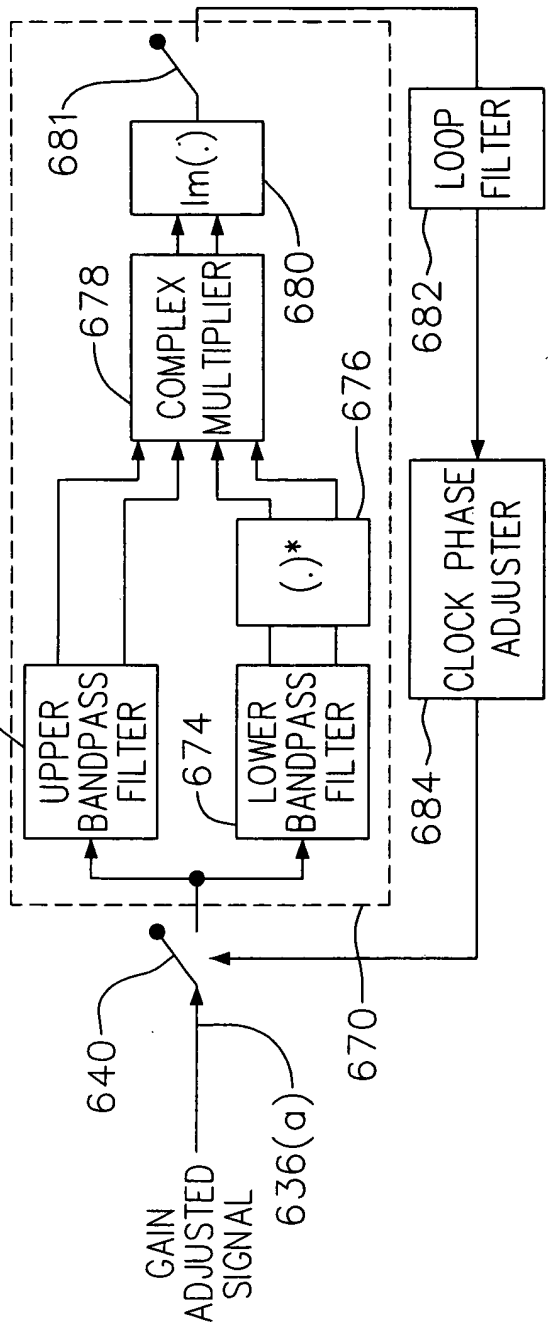
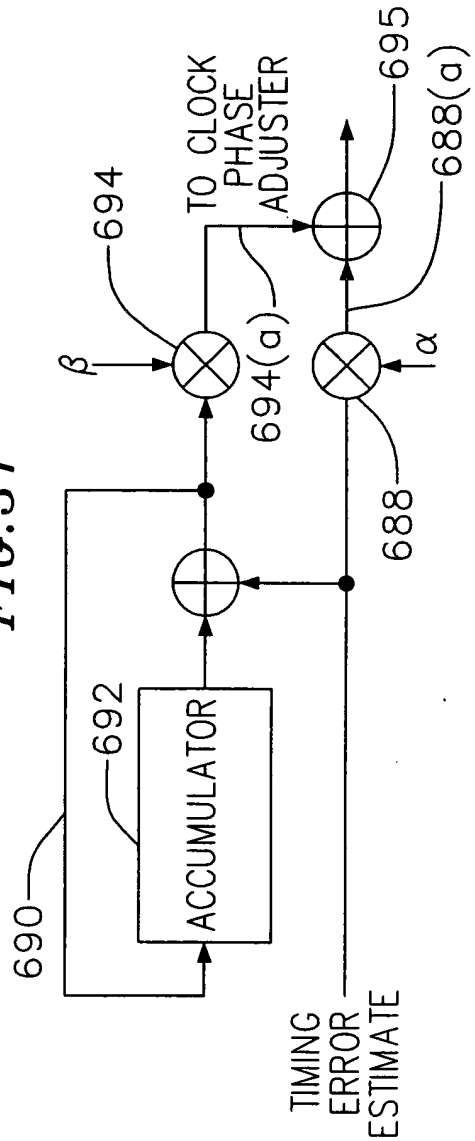

672
UPPER BANDPASS FILTER
674
LOWER BANDPASS FILTER
(.)*
676
COMPLEX MULTIPLIER
678
Im(.)
680
681
LOOP FILTER
682
CLOCK PHASE ADJUSTER
684
640
GAIN ADJUSTED SIGNAL
636(a)
670

FIG. 31


690
692
ACCUMULATOR
694
β
694(a)
TO CLOCK PHASE ADJUSTER
695
688(a)
α
688
TIMING ERROR ESTIMATE

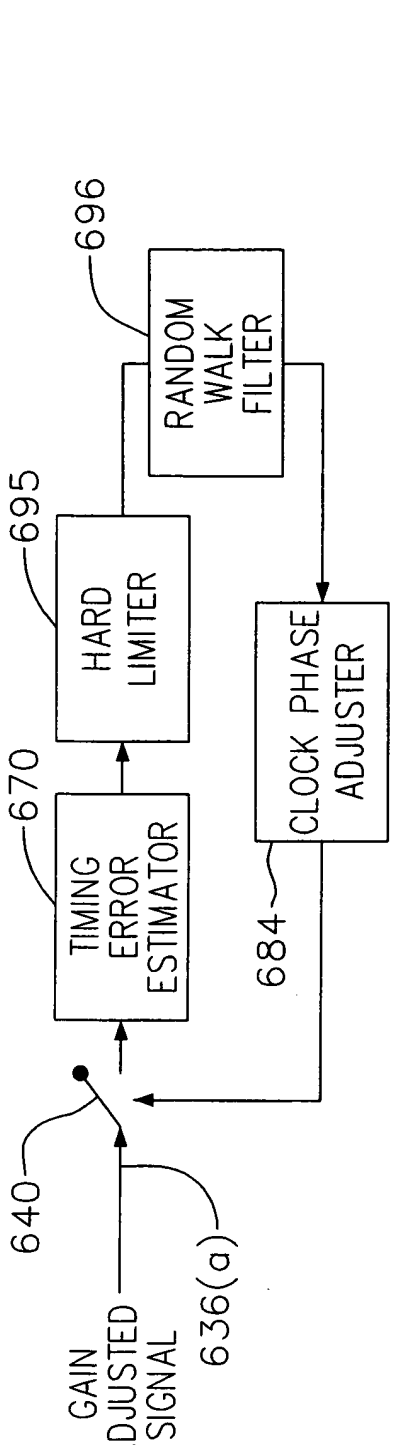

640
GAIN ADJUSTED SIGNAL
636(a)
670
TIMING ERROR ESTIMATOR
695
HARD LIMITER
696
RANDOM WALK FILTER
684
CLOCK PHASE ADJUSTER

FIG. 32

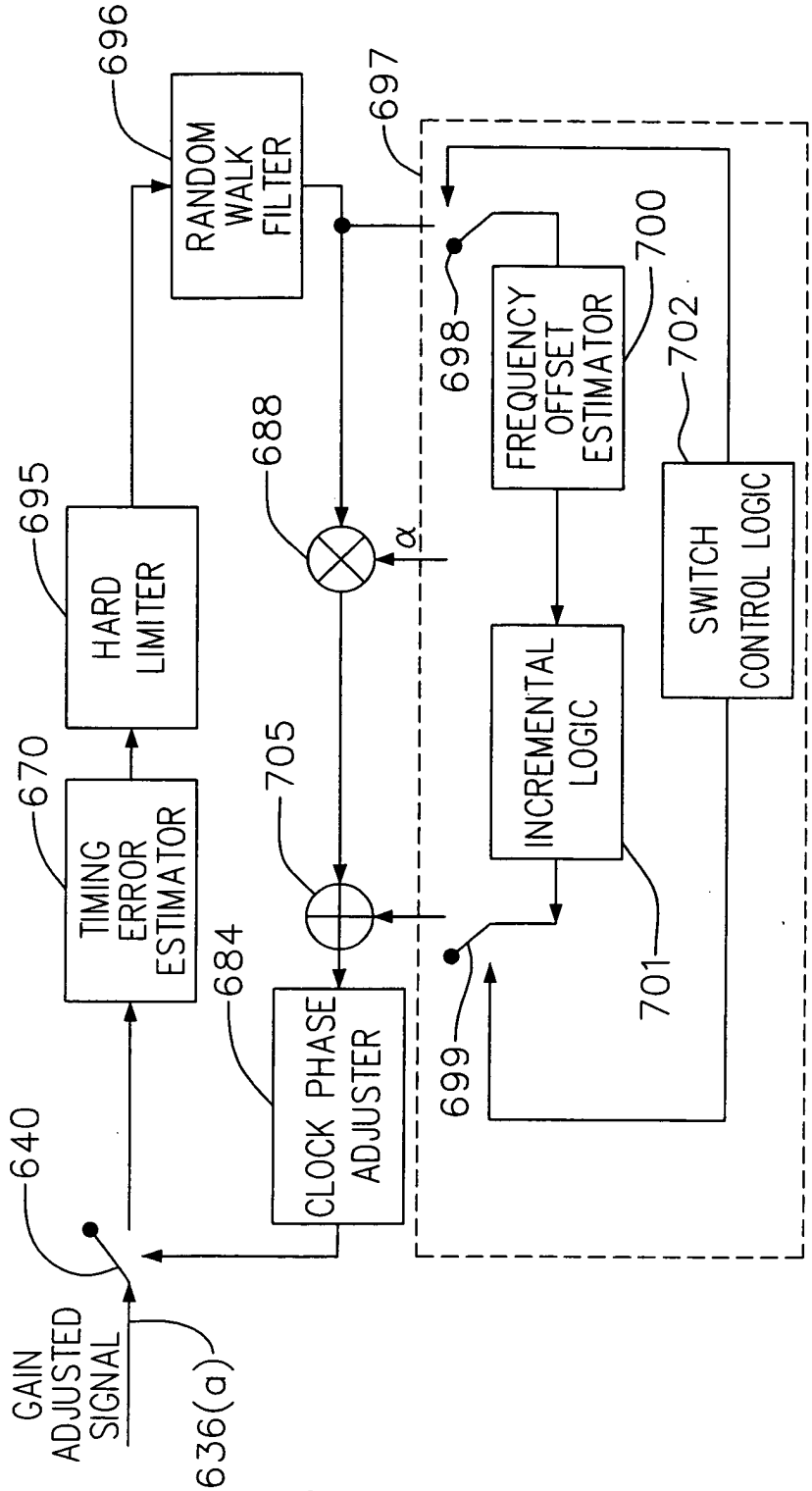
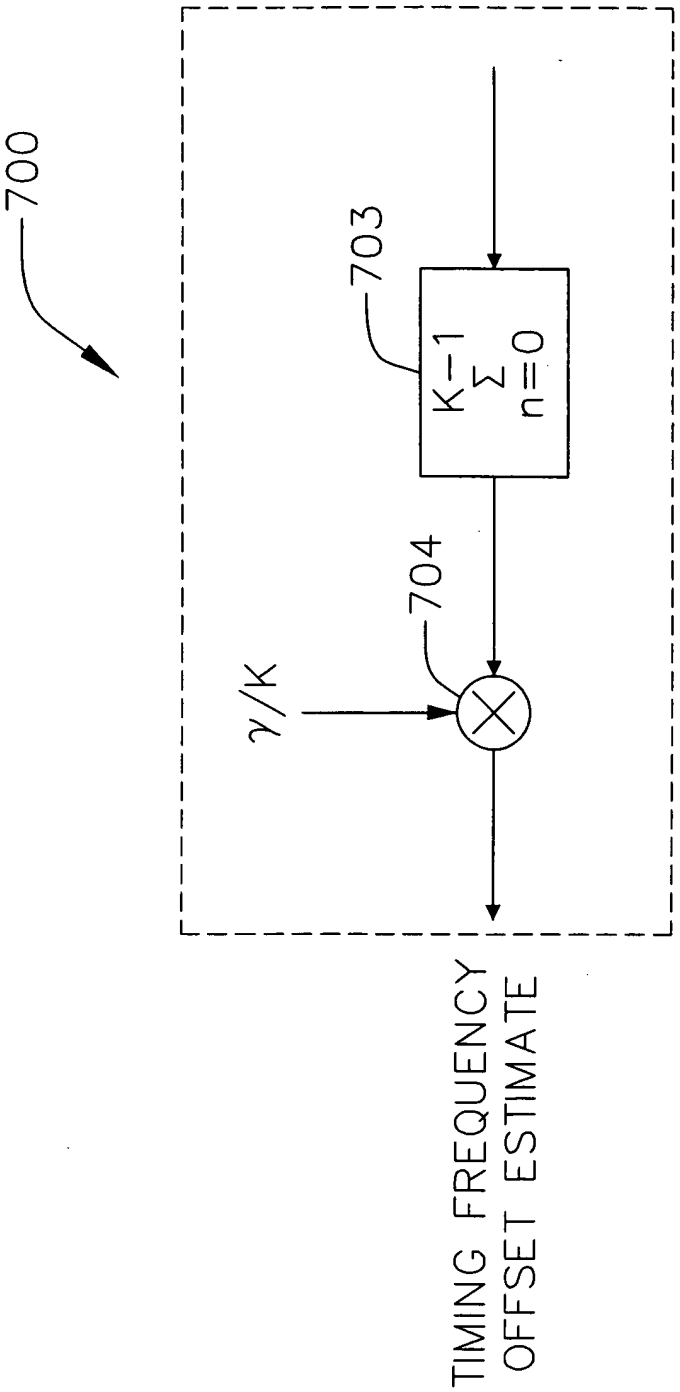

640
GAIN ADJUSTED SIGNAL
636(a)
670
TIMING ERROR ESTIMATOR
695
HARD LIMITER
696
RANDOM WALK FILTER
684
CLOCK PHASE ADJUSTER
688
α
705
697
698
699
FREQUENCY OFFSET ESTIMATOR
700
702
INCREMENTAL LOGIC
701
SWITCH CONTROL LOGIC

FIG. 33

FIG. 34



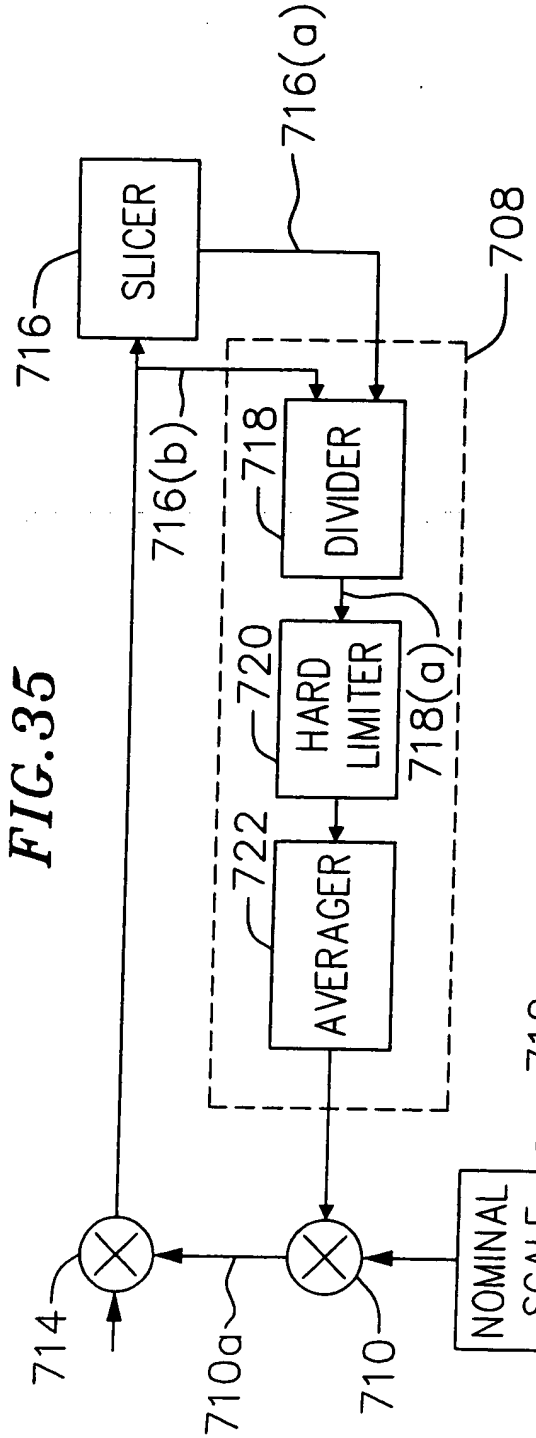

716
SLICER
716(a)
708
716(b)
718
DIVIDER
720
HARD LIMITER
718(a)
722
AVERAGER
712
NOMINAL SCALE FACTOR
714
710a
710

FIG. 35

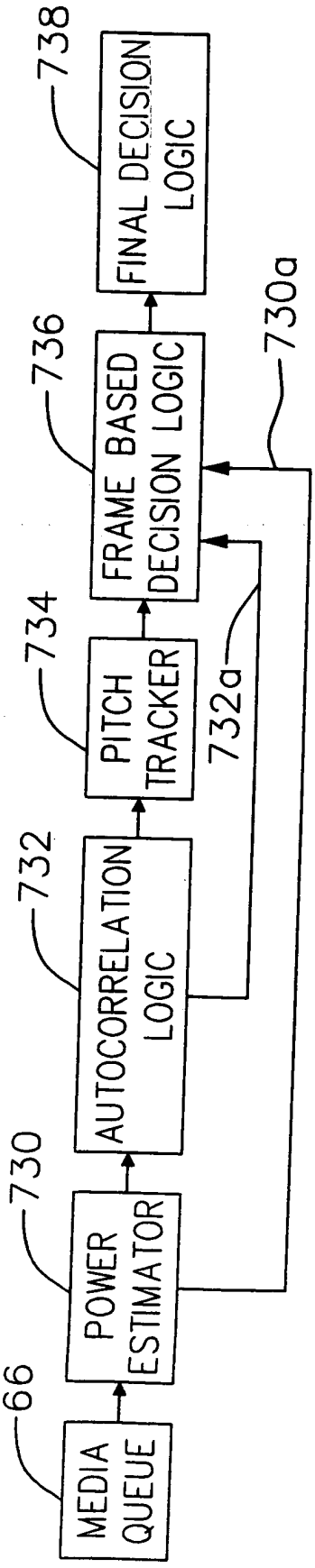

738
FINAL DECISION LOGIC
736
FRAME BASED DECISION LOGIC
730a
734
PITCH TRACKER
732a
732
AUTOCORRELATION LOGIC
730
POWER ESTIMATOR
66
MEDIA QUEUE

FIG. 36